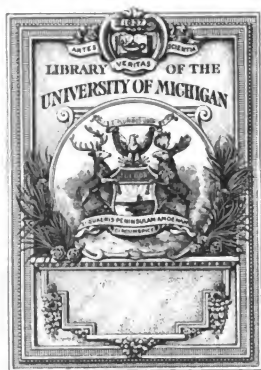


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(WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE.")

A Journal of Practical Chemistry

IN ALL ITS APPLICATIONS TO

PHARMACY, ARTS, AND MANUFACTURES.

EDITED BY

WILLIAM CROOKES, F.R.S., &c.

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THE CHEMICAL NEWS.

VOLUME XXVIII.

EDITED BY WILLIAM CROOKES, F.R.S., &c.

No. 710.—FRIDAY, JULY 4, 1873.

ON BUTTER.*

By J. CAMPBELL BROWN, D.Sc. (Lond.), F.C.S.,
Lecturer on Chemistry and Toxicology at the Liverpool School of
Medicine, Public Analyst for Liverpool, Cheshire, and the Isle of Man.

Definition of Butter.—Pure butter is a fat which has passed through the udder of the cow or other animal as one of the constituents of milk, and which has not been decomposed, by keeping or otherwise, into fatty acids and glycerin.

In milk and cream, the fat is all contained in minute round globules, and butter appears, under the microscope, full of these globules. Chemically, it consists of a mixture of neutral fats, the glycerides of the non-volatile acids, palmitic acid, $(C_{15}H_{31}O_2)$, and butyric acid $(C_4H_9O_2)$; and the glycerides of the volatile acids, butyric acid $(C_4H_9O_2)$, caproic acid $(C_6H_{13}O_2)$, caprylic acid $(C_8H_{15}O_2)$, and capric acid $(C_{10}H_{21}O_2)$. (Wagner and Crookes). The last four glycerides are the characteristic fats of butter.

When butter has been decomposed, the rancid taste and smell make its condition evident to every one. The skill of the analyst is most frequently directed to the detection of fats from the flesh of animals or from the vegetable kingdom. The fats which are generally used as adulterants or as substitutes for butter are suet, tallow, dripping, lard, a mixture of refined fats sold under various names, palm and similar vegetable oils. The most characteristic ingredients in these fats are stearin, margarin, and palmitin.

Stearin is a crystalline fat, melting at 144° F., and solidifying at 124° F., soluble in hot ether, or in seven times its weight of boiling alcohol, but deposited from both these solutions on cooling.

Margarin forms scales, which melt at about 116° F., and are soluble in warm ether.

Palmitin is a solid crystalline fat, melting at from 113° to 143° , and solidifying at 114° . It is readily soluble in ether, sparingly soluble in alcohol. Stearin, margarin, and palmitin are seldom obtained pure; they occur in Nature dissolved in olein and other oils, which lower the melting-point. For instance, mutton and beef suet, lard, and palm oil melt at temperatures from 25° to 55° below the melting-points of stearin and palmitin.

In drawing up the following table for the examination of butter, I have made free use of the observations of Dr. Ballard (*CHEMICAL NEWS*, vol. iv. and v.), and the scheme of Dr. Parkes (*"Hygiene,"* chap. v., section xi.); but I depend chiefly on my own observations on a large number of samples from different sources, made during the years 1871 and 1872.

* From the "Liverpool and Manchester Medical and Surgical Reports, 1873." Communicated by the Author.

Table for the Examination of Butter.

1. Weigh out an ounce of the sample of butter which is to be examined, place it in a test-tube seven-eighths of an inch in diameter, and melt by placing the tube in hot water. Place a thermometer, with a pear-shaped bulb, so that the bulb shall be in the middle of the fat about 1 inch below the surface, and allow the whole to cool spontaneously. If the quantity of water in the butter be large, it will collect in the tube below the fat; the casein will also collect in the lower part of the tube. Watch the mass as it cools, and note when solidification commences and when it is complete. The following are the average solidification-points:—

With pure butter the thermometer is obscured between 74° and 68° , and the mass is solid at 60° .

Beef dripping obscures the thermometer at 79° , and is solid at 72° .

Mutton dripping obscures the thermometer at about 85° , and is solid at 84° .

Lard obscures the thermometer at 84° , and is solid at from 79° to 70° , but it often remains as soft as butter at a much lower temperature.

Mixtures solidify at intermediate temperatures.

2. Determine the quality of the butter by the taste and smell of the re-congealed fat and of the original sample.

3. Examine several portions of the original sample by means of a good microscope, using a $\frac{1}{4}$ -inch or $\frac{1}{2}$ -inch object-glass. In butter made from milk or cream, nothing is seen except the characteristic globules, and the granular masses of curd, and the cubical crystals of salt. The hard fats of butter are present in the globules in a state of solution, and are not recognisable in a separate form.

If stearic acid, stearin, or palmitin be present in separate form, they will be recognised by single fusiform crystals, or star-like aggregations of acicular crystals. They indicate the presence of melted fats.

Other substances, such as starch, flour, palm oil corpuscles, Irish moss, colouring matter, &c., may also be distinguished by the microscope, as distinct from butter or fats.

4. Examine the same portions with the same object-glass, together with a polariscope, consisting of two Nicol's prisms and a selenite plate. The crystals referred to in (3) polarise light, and when viewed by the polariscope are more distinctly defined. Particles of suet and other fats, which have not been melted, may also be distinguished by their action on polarised light, by their amorphous form, and by their membranes.

5. Repeat the microscopic examination after the addition of tincture of iodine, acetic acid, and other reagents usually employed to detect substances other than fat.

6. Weigh carefully a convenient quantity of the sample, say 1 oz., in a tared porcelain dish, evaporate in a water-bath, or in air-bath, at 212° , until free from water, and

weigh again; the difference is the amount of water per ounce, which should not exceed 35 grs. (5 to 10 per cent; Parkes).

7. Dissolve the residue in ether, warming gently until the whole of the fat is dissolved, filter through a weighed filter-paper, collecting the filtrate in a beaker, then wash the dish and filter-paper with ether until a total of 5 or 6 ozs. has been used, and allow the whole to stand for some time at a temperature of 65°.

8. Dry the precipitate on the filter-paper, and weigh; deduct the weight of filter-paper; the remainder is approximately the amount of curd, or casein, and salt.

9. Wash the precipitate with boiling water, dry at 212°, and weigh; deduct the weight of filter-paper; the remainder is the amount of curd or casein, which, in good butter, should not exceed 15 grs. per oz. (3 to 5 per cent; Parkes).

10. Estimate the salt, by means of nitrate of silver, in the aqueous washings from (9), or wash another weighed portion of butter thoroughly with distilled water, and determine the salt by nitrate of silver. It should not amount to more than 8 grs. per oz. in fresh butter (0.5 to 2 per cent; Parkes), or 35 grs. per oz. in salt butter (8 per cent; Parkes).

11. If the ethereal solution of the fat from (7) has formed a deposit at 65°, decant and filter off the clear solution, and examine the deposit, which is probably stearin, according to (12).

Evaporate the ethereal solution down to 4 ozs., and allow it to stand for several hours at 65°. Filter off the deposit, which probably still contains stearin, and examine it also according to (12).

Allow the ethereal solution to evaporate down to 3 ozs., and allow it to stand for some time at 65°. Filter off the deposit, which may still contain some stearin mixed with palmitin, and examine it separately, according to (12). If the butter is adulterated, some of the stearin, and much of the palmitin, will still remain in solution, and may be obtained by continuing the process of spontaneous evaporation.

Some samples of pure butter yield no deposit from 3 ozs. of ether at 65°; but fairly good butter will generally form a slight deposit, the amount of which varies in different samples. A sample of butter known to be pure should be examined side by side with the sample suspected to be adulterated; and, as winter butter is a more solid fat than summer butter, the former should be chosen for the comparative experiment.

12. (a). Place each of the above-mentioned deposits in a thin weighed glass tube, and, after evaporating off the ether, weigh the fat, and determine its melting-point; melt carefully, and allow it to cool gradually. Place a small accurately graduated thermometer with pear-shaped bulb in the melted fat, and observe the temperature at which the latter begins to solidify. When quite solid, re-warm the tube gradually, by placing it in water, the temperature of which is slowly raised, and observe the re-melting-point of the fat.

(b). Or, melt the fats in a thin glass or porcelain dish, floated in water, the temperature of which is slowly raised, a thermometer being placed in the water. In this case the apparent melting-point will be 2 or 3° above the correct figure, but the relative differences between the melting-points of the several deposits will be the same as in (12a).

13. Determine the taste and smell of each of the deposits.

14. The number of grs. per oz. may be reduced to parts per cent by multiplying by the factor 0.22857.

University of London.—The following is a list of the candidates who have passed the recent D.Sc. examination—Branch VI., Electricity—Richard Wormell, M.A., University College and private study. Branch XIV., Geology—Augustus Constable Maybury, Royal School of Mines and University College.

INVESTIGATIONS ON PARASULPHOBENZOIC ACID.

By IRA REMSEN.

(Concluded from p. 280.)

V. Attempts to Prepare Orthosulphobenzoic Acid.

THE fact that in the crude sulphotoluenic acid, employed in the preparation of parasulphobenzoic acid as above described, two varieties are contained, viz., the ortho- and para-; and, further, the fact that the crude product of the oxidation, in the form of the potassium salts, when fused with potassium hydroxide, yielded, as we have seen, salicylic as well as paraoxybenzoic acid, showed plainly that the ortho-acid had not been destroyed by the oxidising agent. The process was in other cases continued for a long time, and a large excess of the oxidising mixture employed; and still salicylic acid was obtained, its quantity, as compared with that of paraoxybenzoic acid, appearing rather to be increased than diminished under these circumstances.

This result was not what might have been anticipated after Fittig had called attention to the fact that ortho-compounds conduct themselves toward oxidising agents differently from the compounds of the two other series, the former being, as he states, completely destroyed, yielding carbonic acid and water. In the case under consideration two explanations might be given: either the orthosulphotoluenic acid had been converted into orthosulphobenzoic acid, or it had withstood the action of the oxidising mixture; for orthosulphotoluenic acid itself, when fused with potassium hydroxide, yields salicylic acid, if the heating be continued long enough, as was shown by Wolkow (*loc. cit.*).

The solution which yielded the acid barium parasulphobenzoate was evaporated down gradually, and, after it was reduced to a small volume, it was still found to contain a considerable quantity of an easily soluble salt, differing entirely from the difficultly soluble parasulphobenzoate. This was re-crystallised a number of times, and finally obtained in the form of microscopic needles; though even after repeated re-crystallisations its appearance hardly warranted the conclusion that it was a pure compound. It was, as stated, easily soluble in water; and the difference between its solubility in cold water and that in hot was not very great; so that the crystallisation was necessarily brought about by allowing the solution to stand for a length of time over sulphuric acid. The salt thus prepared was analysed after being thoroughly dried over sulphuric acid.

0.4215 grm. of the salt, on being heated to 240°, lost		
0.0155 grm. H ₂ O, and then gave 0.2228 grm.		
BaSO ₄ = 0.121 Ba.	Calculated.	Found.
(C ₇ H ₇ SO ₃) ₂ ..	342	68.80
Ba	137	27.58
H ₂ O	18	3.62
	497	100.00

Though the results of this analysis agree but poorly with the calculated percentages, it nevertheless makes it appear exceedingly probable that this easily soluble substance is nothing but the salt of orthosulphotoluenic acid. Acid barium parasulphobenzoate requires much less barium (23.10 per cent) and much more water (3 mol. = 9.11 per cent). The fact that more barium was found than is required by the theory would appear to indicate that the salt was rendered impure by the presence of a small amount of a neutral barium salt of sulphobenzoic acid. As the neutral barium salt of parasulphobenzoic acid corresponds in its properties very nearly to the salt here described, this becomes still more probable. Be this as it is, it is evident that the CH₃ group of orthosulphotoluenic acid has not been acted upon by the oxidising

mixture, nor has the acid been destroyed. The same results were obtained when a large excess of sulphuric acid and potassium bichromate were allowed to act upon the mixture of the two sulphotoluenic acids for a long time; so that the statement of Fittig, that the ortho-compounds are destroyed by oxidising agents, requires qualification. It seems, indeed, from this and a subsequent experiment, that the ortho-acid is acted upon with much less energy than the para-acid, if acted upon at all. This case agrees, however, with those mentioned by Fittig, in the fact that the toluen derivative yields no corresponding derivative of benzoic acid.

The destruction of aromatic compounds is by no means confined to those which belong to the ortho-series. The case of salicylic acid mentioned by Fittig is, indeed, no proof of his general statement, inasmuch as all aromatic oxyacids, as far as I have subjected them to experiment, are destroyed with equal facility. I have, for instance, treated salicylic, oxybenzoic, paraoxybenzoic, protocatechic, and gallic acids with sulphuric acid and potassium bichromate, and in each case exactly the same phenomena were observed. Gentle heating was sufficient to commence the process, which then proceeded violently to the end, accompanied by an evolution of carbonic acid, without the further aid of heat. On now examining the mixture, not a trace of a solid product could in any way be discovered. So that salicylic acid does not differ in this respect from other aromatic acids containing OH; and its conduct toward oxidising agents is, of course, no proof that it belongs to the ortho-series. This does not, however, detract from the value of Fittig's exceedingly interesting observation; it merely serves to define it more accurately.

That the ortho-compound, in the special case under consideration, is acted upon less energetically than the para-compound, was also shown in a rough way by the following experiment:—The potassium salts of the two sulphotoluenic acids were separated very nearly by means of crystallisation. The pure para-salt was introduced into the oxidising mixture, and the reaction that ensued carefully observed. The same quantity of ortho-salt, still containing some of the para-salt, was afterward introduced into the same quantity of the oxidising mixture as was employed in the former case, and the reaction compared with the former one. A striking difference was observed. Whereas the reaction commenced very quickly with the para-salt, and a strong evolution of gas took place; with the ortho-salt, it was necessary to apply heat for a longer time before the reaction fairly began, and then the process was markedly more sluggish, a very slow evolution of gas continuing for a long time. By means of approximate quantitative experiments, further, it was shown that the longer heat was applied to the vessel in which the oxidising process was going on, the smaller was the yield of para-acid; but in no case did I succeed in completely destroying either the ortho- or para-acid. This shows that the para-acid is very susceptible to the action of the oxidising agent, the oxidation taking place apparently at first in the methyl group, and then extending gradually to the whole molecule; whereas the ortho-acid resists the same influence strongly, and if oxidation takes place at all, it breaks up the compound, yielding the last products of combustion. Whether the same is true of other cases I am unable to say; facts do not speak against it at present, and further experiment can alone decide this point, which certainly possesses more than ordinary interest.

I was thus forced to abandon the hope of obtaining orthosulphobenzic acid by the oxidation of orthosulphotoluenic acid by means of sulphuric acid and potassium bichromate. It is possible that other oxidising agents, as, for instance, potassium hypermanganate, may yield more satisfactory results. A preliminary experiment made with this salt in an alkaline solution showed that oxidation took place readily; and I shall soon commence the study of this reaction in detail.

VI. Oxidation of the Amides of Sulphotoluenic Acid.

The difficulty with which ortho-compounds are obtained, and the importance of studying them in a pure condition, in order to complete our knowledge of their conduct under various conditions, led me to undertake one more experiment, with the hope of finding a method for the preparation of orthosulphobenzic acid. The experiment failed to bring about the desired object, but at the same time gave other interesting results, an account of which follows.

According to A. Wolkow (*loc. cit.*), the amides of the two sulphotoluenic acids can be separated from each other by means of crystallisation. This statement offered a prospect of obtaining an ortho-compound in pure condition; and I hence prepared a quantity of the amides from the crude mixture of potassium salts of sulphotoluenic acids. The perfect separation of the two by means of crystallisation is an exceedingly tedious operation, whether water or alcohol be employed as the solvent. From water the paramide crystallises first, and can then easily be purified; from the mother-liquor a mixture of the two amides is deposited. This fuses at 124°, and can only be resolved into its constituents by a very long series of recrystallisations. I succeeded at last in obtaining a small quantity of the ortho-amide in a pure condition, with all the properties as given by Wolkow.

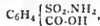
Now, as the amide contains the group SO_2NH_2 instead of the sulpho-acid group SO_3OH , it seemed possible that its conduct toward oxidising agents might differ from that of the sulpho-acids. No attempts had as yet been made to oxidise compounds containing such a complicated group as SO_2NH_2 , and I was obliged to gain a certain amount of preliminary knowledge before proceeding to subject the ortho-amide to oxidation. For this purpose I introduced a few grammes of parasulphotoluene-amide into a noted amount of the oxidising mixture (sulphuric acid and potassium bichromate); and heated the whole gently for a short time. Soon the oxidation began, as was shown by a change in colour and an evolution of gas. The amide dissolved rapidly, and, soon after it had completely disappeared, a beautifully crystallised product began to make its appearance, and increased constantly in quantity. After cooling, the liquid was filtered off. The solid product remained on the filter, after being washed out with cold water, in a pure white condition. It consisted of beautiful, short, lustrous prisms that bore no resemblance to the original amide. It was found to be easily soluble in alkaline carbonates, carbonic anhydride being evolved, and was re-precipitated from these solutions in crystalline form on the addition of mineral acids. It was almost insoluble in cold water, and difficultly soluble in hot water; and, when only once crystallised from water, it had the form of flattened prisms, sometimes more than an inch in length. These had a high lustre, and while in the solution exhibited a very beautiful fluorescence. It was found to fuse at a very high temperature, but to undergo decomposition before this point was reached. These properties distinguish the new substance from the amide of parasulphotoluenic acid. Its composition was determined by the analysis.

(1). 0.8657 gm. of the substance, thoroughly dried over sulphuric acid, were oxidised in a silver basin with saltpetre and potassium hydroxide (Liebig's method). There were obtained 1.03 grms. $\text{BaSO}_4 = 0.17416$ gm. S.

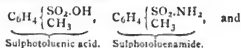
(2). 0.5505 gm. of the dried substance were heated with soda-lime, and the vapours collected in dilute hydrochloric acid. In this way were obtained 0.262 gm. Pt. corresponding to 0.37163 N.

	Calculated.	Found.
$\text{C}_7\text{H}_5\text{O}_4$	55	77.11
S	32	15.92
N	14	6.97
	201	100.00

These results agree with the formula—

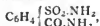


and this formula agrees with the method of formation of the substance. We have—



I have given the acid the name *parasulphaminobenzoic acid*, as indicating the constitution which it undoubtedly possesses.

A compound of a similar constitution, but belonging to another series, is already known, viz., the so-called *sulphobenzoic acid*. This was prepared by Limpricht and Usler*, and by Engelhardt.† The former obtained it by heating sulphobenzenamide—



or ammonium ethylsulphobenzoate, with potassium hydroxide; further, by treating the compound $\text{C}_7\text{H}_6\text{N}_2\text{SO}_2$ (obtained from sulphobenzenamide by treating with phosphorus chloride) with caustic potassa. In both cases ammonia is eliminated. Engelhardt obtained it by means of a complicated reaction, viz., the action of sulphuric anhydride on benzonitrile, other products being formed at the same time. Sulphobenzoic acid being derived thus from ordinary (meta) sulphobenzoic acid retains, in all probability, the meta-position of the substituting groups; and, although it is not proved by experiment, it is probable that the amide group is in this case also situated in the sulpho group, and not in the carboxyl. The name would indicate the contrary; but the analogy that this compound shows with parasulphaminobenzoic acid, in which the amide group is undoubtedly situated in the sulpho group, leads me to believe that the name is incorrect, and that the name *metasulphaminobenzoic acid* would be more in accordance with the internal character.

To the account given above of the method of preparation and the properties of parasulphaminobenzoic acid, I need only add a few details. For the oxidation the following proportions were found to be most favourable:—To 20 grms. of potassium bichromate are taken 30 grms. of ordinary sulphuric acid, diluted with three times its volume of water; this mixture sufficed for the oxidation of 7 grms. of the pure amide. The amide is introduced into the mixture after the latter has become cool. At first the flask is heated by means of a very small gas-flame. A moderately violent action takes place, and in a short time the amide is entirely dissolved; now in a few minutes the separation of the oxidation product begins. The mass increases constantly in quantity until the liquid has the form of a thick paste. In about an hour from the beginning of the process the oxidation is completed. The whole is now allowed to cool down to the ordinary temperature, the product is filtered off and washed out with cold water, until the wash-water passes through colourless. On the filter is the parasulphaminobenzoic acid in the form of beautiful crystals, which only require to be re-crystallised from water once in order to be made perfectly pure. It is easily soluble in alcohol, and crystallises from this solvent in smaller crystals than are obtained from water; and these do not exhibit the property of fluorescence. It is precipitated in crystals, both from a hot and cold alcoholic solution, by water.

Sulphuzamic acid crystallises, according to Limpricht and Usler, in scales like potassium chlorate; according to Engelhardt, in rhombohedral crystals or in

needles consisting of aggregates of small rhombohedrons. Heated above the melting-point, it volatilises in white vapours. Distilled with phosphorus pentachloride, it yields a number of products, among which is metachlorobenzoyl chloride. It may be expected that parasulphaminobenzoic acid will under the same treatment yield parachlorobenzoyl chloride, a point which I shall decide by experiment.

Ethyl parasulphaminobenzoate—



This beautiful compound is the most characteristic derivative of the acid. It is prepared in the usual manner by conducting dried hydrochloric acid gas into a solution of the acid in absolute alcohol, and afterward heating gently on a water-bath. Water gives no precipitate in the solution thus obtained. The alcoholic solution must be evaporated down to the consistence of syrup; it then congeals on cooling, and consists of a mass of fine, colourless needles. In water it is less soluble than in alcohol; in cold water much less than in hot. When boiled with water, it melts in the liquid before dissolving. From the aqueous solution it separates in the form of long, beautiful needles of a silken lustre. These arrange themselves nearly parallel, and may attain the length of several inches. In connection with the melting-point, this substance exhibits interesting though perplexing phenomena. In order to be sure that it was absolutely pure, I subjected it to re-crystallisation a number of times; though each time it was obtained in the same form, and possessed in the highest degree the appearance of a chemically pure substance. On endeavouring to determine the melting-point, however, I was surprised to find that this varied according to circumstances. When first heated, it melted entirely at 110° to 111° ; if it were now removed from the bath, and allowed to solidify, it melted immediately after at 94° to 95° ; the longer it was allowed to stand after the first melting, the higher the melting-point became, until finally, in about two hours, it again reached 110° to 111° . Specimens examined at different intervals showed melting-points which varied between the limits mentioned; every time that the substance was melted once and then allowed to congeal, and again immediately examined, the melting-point was found to be $94^\circ 95'$. This, taken together with the fact that the substance was pure, is certainly very remarkable. It is possible that this case belongs in the same category with that observed by Zincke* in connection with the two modifications of benzophenone, which is in its turn decidedly inexplicable.

Of the ether, a sulphur estimation was made as follows:—0.2849 grm. of the substance, dried over sulphuric acid, were oxidised with KOH and NO_3K (Liebig's method), and gave 0.2903 grm. $\text{BaSO}_4 = 0.03987 \text{ S}$.

	Calculated.	Found.
$\text{C}_8\text{H}_{11}\text{O}_4\text{N}$	197 86.03	—
S	32 13.97	13.99
	229 100.00	

Ethyl sulphobenzenamate also crystallises, according to the description, in "splendid, shining needles"; these were determined to be monoclinic prisms. No determination of the melting-point appears to have been made. "It dissolves easily in warm alcohol; somewhat less easily in boiling water."

Barium parasulphaminobenzoate, $(\text{C}_7\text{H}_5\text{SO}_4)_2\text{Ba} + \text{H}_2\text{O}$. This salt is prepared by boiling the acid with barium carbonate. It is easily soluble in cold and hot water, and crystallises in nodular aggregates.

The analysis gave the following results:—

0.497 grm. salt, dried over sulphuric acid, lost, at 200° , 0.0161 grm. H_2O ; and gave 0.2094 grm. $\text{BaSO}_4 = 0.12313 \text{ grm. Ba}$.

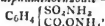
* Ann. d. Chem. u. Pharm., cxi., 27.
† Jahresberichte, 1858, S. 278.

* Berliner Berichte, IV. Jahrgang, 376.

	Calculated.	Found.
(C ₇ H ₅ SO ₄ N) ..	400 72.08	—
Ba... ..	137 24.68	24.77
H ₂ O	18 3.24	3.24
	555 100.00	

The corresponding salt of sulphobenzamic acid crystallises with H₂O as "a soft, waxy, crystalline mass;" it gives off its water at 110°.

Ammonium parasulphaminobenzoate—



prepared by dissolving the acid in ammonia, is easily soluble in cold and hot water. It easily forms supersaturated solutions, which congeal on being disturbed. It crystallises in beautiful needles or long laminæ.

The ammonium salt of sulphobenzamic acid crystallises in laminæ.

The new acid is thus sufficiently well characterised as a chemical individual by these experiments; but, as it represents a class of derivatives differing from others in their more complicated nature, it deserves a more thorough examination. It is susceptible to the action of ordinary reagents, and yields compounds with them. It can be boiled with concentrated nitric acid without undergoing change, it being thrown down in crystalline form on the addition of water. It is insoluble in fuming nitric acid at the ordinary temperature; but dissolves when heat is applied. On the addition of water to the solution no precipitate is formed; on evaporating, however, a very easily soluble, colourless, crystalline product was obtained. Fuming sulphuric acid also dissolves it with the aid of heat, and as water gives no precipitate with the solution, it is probable that a sulpho-acid is formed; though in this connection it should be remembered that the isomeric body, sulphobenzamic acid, appears to yield sulphobenzic acid when treated with sulphuric anhydride (Limpricht and Usalar). The study of these reactions I shall take up in due time. Parasulphaminobenzoic acid having a symmetrical structure, the investigation of its sulpho acid offers a possibility of throwing light upon the constitution of the tribasic acids of benzine; the conversion of the two sulpho groups into carboxyl may succeed, though, after the experience of Ascher* with sulphoterephthalic acid, this is hardly probable.

I have already stated that the object of undertaking the oxidation of the amides of sulphotoluenic acids was to open another road with the hope of arriving in the end at a method for the preparation of orthosulphobenzic acid; I also stated that this object was not attained. Orthosulphotoluenamide still containing some of the paramide was subjected to oxidation. It was immediately noticed that, as in connection with the sulpho acids, the action in this case was not as violent as in the case of the para compound. After heating for some time the product was examined. The parasulphaminobenzoic acid formed was filtered off, and the filtrate extracted with ether. The ethereal extract, on being distilled, left behind a residue consisting of orthosulphotoluenamide with a very little parasulphaminobenzoic acid. The latter can be readily removed by re-dissolving the whole in water, adding a little alkali to the solution, and then again extracting with ether. In this way absolutely pure ortho-amide can be obtained. This was again subjected to oxidation, and, after treating for a length of time, no new product could be discovered in the liquid—a portion of the substance only having been destroyed. Thus we see that the conduct of the ortho amide is exactly analogous to that of the corresponding sulpho acid; and this serves to strengthen the conclusion drawn in regard to the conduct of ortho compounds in general toward oxidising agents.

The points which have been left unsettled thus far in this investigation will be considered in a second paper on a basis of experiments.—*Am. Journ. Sci.*

* *Ann. d. Chem. u. Pharm.*, cxi., 3.

ON THE ENERGIES OF THE IMPONDERABLES,
WITH ESPECIAL REFERENCE TO THE
MEASUREMENT AND UTILISATION OF THEM.*
By the Rev. ARTHUR RIGG, M.A.

LECTURE I.

Introduction—Inter-Relations—Units of Measurement, &c.

"Imponderables," as a technical term, was in the last century a name given to those fluids which were supposed to convey electricity, light, heat, &c.; and, because these fluids could not be isolated and weighed, all that men received through their agency were also named "imponderables." These phenomena are now regarded as being due to motions in ponderable matter, and they are considered rather as forces causing motion in this matter, than either as fluids, or as that which can be conveyed, i.e., carried, by fluids. The term is, however, retained as a brief mode of expressing the subject of this course of lectures, especially as no one can confidently assert that it may not again be reinstated in the position it once occupied.

The "energies of the imponderables," then, is a phrase comprehending all results of those unseen, unknown, and, by man, unweighable powers which pervade space. By such powers, the very sun and planets and stars are so influenced that they move in harmonious union or oneness, and, therefore, the name universe is applicable. With this extensive view of the influences and actions of the imponderables, these lectures are not to be concerned. The bounds of them are, however, easily defined. This earth, and that which man can utilise upon it, are our limits. Even when thus "cabined, cribbed, confined" to the earth and the handwork of men, still those who have perused and thought over the title, viz., "The Energies of the Imponderables, with especial reference to the Measurement and Utilisation of them," may have commented upon it in spirit, saying, "Fools rush in where angels fear to tread." When body, form, and fashion were first given to the scheme of this course, that great was the presumption, and that great, therefore, would be the failure, were not unknown feelings.

The causes of such views are simple and easily made clear. The energies of the imponderables have, in one form or another, occupied the attention of the most thoughtful, as well as the most practical, men in every age. They may not have given this name to the subject of their investigation, but, call it what you will, the ultimate source of all power that Nature gives to man is to be found in the energy of one or more of those unknown agents to which the name of imponderables has been given. To dwell upon this now would be to anticipate the series of lectures. It may suffice to state that the object of the course is to bring before you illustrations of the modes in which men have been led, or are now being led, to define not only the ways, and varieties of ways, in which each imponderable acts, but also to estimate by those measurements to which men appear in material things, the amount or value (if the word be preferred) of that work in material things done by these imponderable elemental powers. To do this involves references, perhaps, in a few words, to conclusions at which a life of self-devotion to one cause may have arrived, that life, too, being aided by the very highest of cultivated mental intelligence and the capability of employing such powers of scientific research, the very alphabet of which is beyond the attainment of the majority of men.

Whilst thus frankly, and at the outset, admitting how high a class of mind is required for these original investigations, it must not be overlooked that the principles which have governed the researches of these men, and the conclusions at which they have arrived, may be appreciated by many minds.

When the late Mr. Faraday was discoursing "On the

* The Cantor Lectures, delivered before the Society of Arts.

Conservation of Force," he made a statement in relation to an observing and a mathematical mind which will have more weight by your generalisation of his words than by my dilution of them. Hence this quotation:—

"It may be supposed that one who has little or no mathematical knowledge should hardly assume a right to judge of the generality and force of a principle such as that which forms the subject of these remarks. My apology is this:—I do not perceive that a mathematical mind, simply as such, has any advantage over an equally acute mind not mathematical in perceiving the nature and power of a natural principle of action. It cannot of itself introduce the knowledge of any new principle. Dealing with any and every amount of static electricity, the mathematical mind can, and has, balanced and adjusted them with wonderful advantage, and has foretold results which the experimentalist can do no more than verify. But it could not discover dynamic electricity, nor electro-magnetism, nor magneto-electricity, or even suggest them; though, when once discovered by the experimentalist, it can take them up with extreme facility. So, in respect to the force of gravitation, it has calculated the results of the power in such a wonderful manner as to trace the known planets through their courses of perturbations, and, in so doing, has discovered a planet before unknown. There may be results of the gravitating force of other kinds than attraction inversely, as the square of the distance of which it knows nothing can discover nothing, and can neither assert nor deny their possibility or occurrence."

Influenced by such views as these, it seemed that no disrespect to the highest intellect could accrue from an attempt to make clear, even to the lowest, a few of the fundamental principles from which important truths have been evolved. It must be borne in mind that to illustrate the modes by which these energies have been measured and utilised, and not to make any attempt at measuring them, is the leading principle which, thus early enunciated, may prevent misconceptions of the title.

The very words, "Energies of the Imponderables," are, to some minds, terms and not realities—symbols, like political watch words, serving only to classify their professors—things for *savants* to discourse upon—provinces in that intellectual dreamland in which natural science is supposed to dwell. To the majority of men, to those who toil for their daily bread, and, with all their toiling, find but scant supply, the monastery of science, in which her monks live apart from the world and all its vulgar cares, seems a paradise in which is no unrest. Such is only one of many thousand delusions. Within the thinly-peopled world of those who investigate the laws of Nature, there are all the pleasures and pains which meet the labourer with his spade, the mechanic with his tools, the merchant in his office, or the statesman in his cabinet. It is because students and investigators of Nature's laws live much alone—because they cultivate a species of clanship—because there is amongst them a kind of Hindoo caste—that they are seldom in contact and companionship with the toilers in material things. This is much to be regretted. Although both parties are losers, yet the toilers in material things are by far the greatest losers.

Such men as these are the true pioneers of the human race, and that army is ill-directed which allows the work of preparation done by its pioneers to be so far in advance that the mountains they had levelled were again piled up, the rivers they had dried were again flowing, and the thorns once cleared from the desolate prairies were again rendering the ground unfruitful. The men of science are they who give the sap of vitality to the tree of commerce. Society plucks the fruit, and seldom waters the plant. Such has been, and such still is, the case with investigators of natural science, if the men amongst whom they live take the fruit and care neither for the gardeners nor the garden.

Look at the world—the beautiful glass in some of our

stained windows is a lost art. Look at the temples in India, illustrations of which the photographs so truthfully reproduced in this room a few weeks since. Civilised Europe and self-satisfied England cannot, either by their St. Peter's at Rome or those recent productions which we are bound to recognise as the highest attainment of national architecture,—the Albert Hall and adjacent memorial,—approach even at a distance. These temples of a religious profession, with which we are not even acquainted, and of which no records remain, abound in an architecture with which neither in its conception nor in its detail have we ought to compare. And of the materials the men of that age used, we may say the stone is stone still; the sharpness of the carvings is sharpness still.

Is all our dolomite a bastard dolomite? Why are we in England obliged to seek for Italians to form our moulds—to pour in the clay, and to sculpture the marble? Why do we go to Germany for our draughtsmen, our science, and our music, and to France for our adornments and our designs?

One illustration of the neglect of obviously social gain from want of scientific attention cannot, in this room, be out of place.

The Society of Arts was founded in 1753, and when the scientifically practical and theoretical minds of Count Rumford and others considered on what basis and why the "Royal Institution of Great Britain" should be founded, they expressed the objects of thus founding a Society which should supplement the work of the Society of Arts in the following title-page to the charter of 1800:—

ROYAL INSTITUTION

GREAT BRITAIN,
For Diffusing the Knowledge and Facilitating the General
Introduction of
USEFUL MECHANICAL INVENTIONS & IMPROVEMENTS,
And for Teaching by
COURSES OF PHILOSOPHICAL LECTURES AND EXPERIMENTS
THE
APPLICATION OF SCIENCE
TO THE
COMMON PURPOSES OF LIFE.

In reference to the necessity for so supplementing the work done here by our predecessors, in order to "advance the applications of science to the common purposes of life," the then managers state that "the giving of premiums to inventors was done by a most respectable society (the Society of Arts), but to diffuse knowledge needed another incorporation."

Whilst admitting how nobly the Royal Institution has done good work, and how generations yet unborn will look back with reverential gratitude to the boons which those who have laboured within its walls have conferred upon men, it is curious to mark how the views of its founders, and the one great purpose of its formation in 1800, are being realised by the Society of Arts in 1873.

In 1800 the managers of the Royal Institution, as their first act, constituted fourteen committees, for the following purposes:—

1. To investigate the various processes used in making bread, with a view to their improvement.
2. To investigate means for producing cheap and nutritious soups for feeding the poor.
3. Improvement of cottages and cottage fire-places.
4. Improvements in the construction of stoves for warming dwelling-houses.
5. Improvements in kitchen fireplaces and kitchen utensils of private families.
6. Improvements of the most useful articles of household furniture.
7. To ascertain, by experiment, the effects of various processes of cookery upon the food of cattle.
8. Improvement of kitchen fireplaces and kitchen utensils used on shipboard.
9. Improvement of lime-kilns.
10. Ascertaining the effects of mixing clay, &c., with coal-dust and cinders, in forming fire-balls and combustible cakes.

11. Improving the composition of mortar and cements.
12. To ascertain the best method of building cottages and farm-houses with earth rammed together.
13. A committee of mechanics for the improvement of useful machines of all descriptions.
14. A committee for improving the various processes necessary in producing iron from its ores, and in working and refining of iron and steel.

Thus did one noble foster-child of this Society prescribe its own duty, and, child-like, neglect that particular duty; and now that the child has attained the age of threescore years and ten, the nursing mother, by gold medals and money rewards, steps forward to complete the work begun by her foster-child,* and further, by these annual Cantor Lectures, she now does that which—not being done in 1800—led to the formation of the "Royal Institution of Great Britain."

This comes of the people of a country allowing the science of a country to dwell alone. All advances are first suggested by men who observe and think; they are extended by men who reason and test; they are utilised by men who act.

The pioneers of an army are not the fighting men; sailors navigate the ship; marines do the warfare.

The men who investigate the laws which govern the energies of the imponderables are not the men to utilise and apply them. The practical knowledge,—the stimulus of interest,—the capital of the manufacturer, are wanting to the philosopher; while the manufacturer on his part is equally in want of the general information and accurate reasoning of the man of science. When the commercial element enters, and another object of regard is set up for worship, the man of science cannot serve two masters; he cannot serve science and mammon. The more earnestly and heartily he serves the former, the less he bows to the latter. The service of natural science has within itself far more ennobling mental rewards than mammon can confer.

Longfellow, in his letter to Agassiz, on his fiftieth birthday (28th May, 1857), after alluding to the sacrifice he made of his country and his home, for the cause of natural history, well expresses what he feels who, single-minded, teaches men to read what is still unread in the manuscripts of God. Agassiz is described as—

"He who wandered away and away,
With Nature, the dear old nurse,
Who sang to him night and day
The rhymes of the universe."

And then comes a reward more welcome than money or honours—

"For whenever the way seems long,
Or his heart begins to fail,
Nature sings a more wonderful song,
Or tells a more marvellous tale."

This course of Cantor Lectures, in relation to the energies of the imponderables, is to be an attempt to occupy the border-land between pure scientific research and the ministrations to social needs; to tread, in fact, upon neutral ground, to launch our boat upon the Rubicon

* A sum of £500 having been placed at the disposal of the Council of the Society of Arts, through Sir William Bockin, by a gentleman who does not wish his name to appear, for promoting, by means of prizes or otherwise, economy in the use of coal for domestic purposes, the Council have decided to offer the following prizes:—(1). For a new and improved system of grate suitable to existing chimneys as generally constructed, which shall, with the least amount of coal, answer best for warming and ventilating a room.—The Society's Gold Medal and Fifty Pounds. (2). For a new and improved system of grate, suitable to existing chimneys as generally constructed, which shall, with the least amount of coal, best answer for cooking food, combined with warming and ventilating the room.—The Society's Gold Medal and Fifty Pounds. (3). For the best new and improved system of apparatus which shall, by means of gas, be most efficiently and economically warm and ventilate a room.—The Society's Gold Medal and Fifty Pounds. (4). For the best new and improved system of apparatus which shall, by means of gas, be best adapted for cooking, combined with warming and ventilating the room.—The Society's Gold Medal and Fifty Pounds. (5). For any new and improved system or arrangements, not included in the foregoing, which shall efficiently and economically meet domestic requirements.—The Society's Gold Medal and Fifty Pounds.

which divides the provinces of science from those of commerce. It does not aspire to any claim on the nests of science; they who build them are welcome to the imagined and worthless immortality of a name. It does not propose to commerce new modes of amassing wealth. They may keep their wealth who can. But it does seek to bring before those whose daily bread and daily luxuries are derived from science, illustrations of some of the truths on which their daily labour rests. It will try to do this in plain and simple form, divested of those higher studies through which these truths have been in some measure attained, and in a thousand ways extended.

That the work is one worthy of all human intelligence may be inferred from the official document given by the authorities of that incorporation of men who are the real rulers of the earth, properly so called. Statesmen and politicians may influence the minds and bodies of men, but engineers influence all material things.

The Institution of Civil Engineers, established in 1818, long before passenger railways, telegraphs, &c., &c., were known, and now numbering among its members men in all parts of the globe, clearly and aptly defined the objects of their incorporation in words well fitted to the purposes of our present consideration. They then (in 1818) defined the object of their association to be "The acquisition of that species of knowledge which constitutes the profession of a civil engineer, whereby the great sources of power in nature—i. e., the energies of the imponderables—are converted, adapted, and applied for the use and convenience of man."

It may be said, and with some show of reason, when the comprehensive title of these lectures is considered, a little well or completely done is better than much ill or very partially done. As a principle in education this is a truism which the Committee of Council on Education and our various School Boards would do well to adopt and illustrate; but these Cantor Lectures are not to be scholastic lessons; they may teach, but the primary object of them is rather to be suggestive of thought—to give the minds of hearers and readers food for reflection, material for development, to arouse inquiry, to provoke investigation; to leave, in fact, an unsatisfied impression that there is more than the lecturer has expressed—and there is much for hearers and readers to consider. If thus they only lay in the foundations of knowledge, and in rough and sketchy outline show the superstructure, they will have done good service—they will have stimulated research, and so led to the acquisition of knowledge and a habit of mind more valuable far than any which can be given from this platform to you who sit at ease on those cushioned seats, willing to rest for a while under the delusive spell that the Society of Arts has thus found a right royal road (and perhaps a pleasant one) to learning. Such an unsatisfied feeling in relation to the energies named, and the measurement and utilisation of them, it is the object of this course to endeavour to create. If this result be attained, then in those future years, when by individual labour present difficulties are overcome, and light shines where thick darkness now over-spreads, there will be cause for thanks, where, perhaps, when these lectures end, an unsatisfied longing may alone be found.

(To be continued).

CORRESPONDENCE.

ACETAMIDE AND ETHYLATE OF SODIUM.

To the Editor of the Chemical News.

SIR,—My letter, which does not seem to please Mr. Hartley, has caused him to rectify an error into which he is reported to have fallen.

According to the report in the CHEMICAL NEWS, Mr. Hartley said that ammonia is given by the action of

acetamide on ethylate and methylate of sodium. Dr. Armstrong, too, is reported to have obtained ammonia in the same manner. The truth appears to be, however, that acetamide yields no ammonia by action on ethylate and methylate of sodium; but that soda acetamide and caustic soda yield ammonia, and caustic soda always accompanies ethylate of sodium, unless very special precautions be taken to ensure its absence.

Whether Mr. Hartley and Dr. Armstrong said what they are reported to have said, is a question between them and the reporter. My object in writing my letter was to rectify an error, and I believe that I have attained it.—I am, &c.,

J. ALFRED WANKLYN.

London, June 30, 1873.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopaedic list of chemical papers published abroad during the past year, with abstracts of all susceptible of advantageous abridgement. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, June 9, 1873.

Presence of Avic Acid in a Sample of Guano, and Remarks on the Estimation of the Commercial Value of Manures in Accordance with their Elementary Composition.—E. Chevreul.—In May, 1866, the author discovered in the suint of sheep a substance to which he gave the name of *elic acid*. It is perfectly liquid below 16° , and becomes somewhat viscous at 15° to 14° . In 1869 he extracted from this *elic acid* another substance which he named *avic acid*, because it had a "smell of birds." In 1871 he accidentally recognised the same acid in the feathers of an albatross. He now maintains that he has discovered the same principle in guano. This leads him to urge the importance of immediate or proximate organic analysis as applied to manures in contradistinction to mere ultimate or elementary analysis. The most important study for the progress of agriculture is the determination of the immediate principles of soils and manures, and that of their organoleptic properties. As regards manures, the great point is the study of their immediate principles viewed in relation to the immediate principles of the chief arable soils. The author has shown how soils of different natures act differently with regard to the oily principle which is one of the ingredients of colza oil-cake. The neglect of the proximate analysis of manures explains why *avic acid* has not been recognised in guano. In analysing some new samples of that manure from Peru he found *avic acid*, along with carbonate of ammonia in the first, nearly colourless, washings with water. Its odour is not distinctly perceptible until the carbonate of ammonia has been completely evaporated. Guano, he finds, can be entirely freed from carbonate of ammonia by a temperature of 90° .

Researches on New Derivatives of Propyl.—A. Cahours.—He prepares glucinium propyl by acting upon mercury propyl with the finely-divided metal at the temperature of 130° to 135° in a sealed tube. It is a colourless liquid, boiling at 244° to 246° , and giving off dense fumes without becoming ignited. If cooled to -17° it takes the appearance of a fatty oil. Water decomposes it with violence, producing a copious evolution of gas, and an abundant deposit of hydrated glucina. By a similar process he has prepared glucinium-ethyl; which boils between

185° and 188° , and gives off inflammable vapour. Water decomposes it in the same manner as glucinium-propyl. It is also attacked by absolute alcohol, the sides of the tube becoming covered with a transparent crystalline substance. By acting with chloride of silicon upon anhydrous propylic ether the author has obtained compounds analogous to Ebelmen's orthosilicic ether, and to the silicic, mono-, di-, and trichlorhydrines of Friedel and Crafts. The bodies thus obtained are silico-propionic ether, and silico-propionic, mono-, and dichlorhydrines. Boropropylic ether was obtained by passing very slowly a current of perfectly pure chloride of boron into anhydrous propylic alcohol maintained at a temperature bordering upon zero. The compound in question is represented by the formula $\text{Bo}(\text{C}_3\text{H}_7\text{O}_2)_3$. Liebig and Wöhler obtained a crystalline product, known as allophanic ether, by causing the vapour of cyanic acid to act upon absolute alcohol. Hofmann obtained the same compound by allowing alcohol to act upon urea in a cohobator. In this case the formation of allophanic ether is constantly accompanied by that of urethane or carbamic ether. The author, by replacing ethylic alcohol with propylic alcohol prepared propylic allophanate in nacreous laminae, sparingly soluble in cold water, but readily soluble in boiling water and alcohol, and fusible between 150° and 160° . Its composition is $\text{C}_{10}\text{H}_{14}\text{N}_2\text{O}_6$. Propylurethane, $\text{C}_5\text{H}_9\text{NO}_4$, is obtained in the form of long, colourless, brilliant crystals, easily soluble in water, alcohol, and ether. It fuses between 51° and 53° , and boils at 104° to 106° . If moist it is decomposed by heat, and yields large quantities of ammonia.

Part Played by Atmospheric Nitrogen in Vegetation.—P. F. Dehérain.—The author has previously announced that he had succeeded in fixing atmospheric nitrogen upon the black matters formed during the decomposition of the hydrates of carbon. In more recent experiments he has shown that this fixation takes place at common temperatures, and that it is due to the formation of ammonia. Thus, in one of his experiments the absorbent matter was glucose and ammonia; amount of free nitrogen at the beginning of the experiment, 38 c.c.; ditto, at the conclusion, 21 c.c.; nitrogen taken up, 17 c.c., or 44.7 per cent of the original amount. The presence of cyanides could not be recognised in any of these experiments. It is established that the fixation of nitrogen by carbonaceous matter which takes place at 100° ensues also in the cold, though with less energy. An atmosphere poor in oxygen favours the fixation.

Boiling-Points and the Molecular Volumes of the Chlorated Isomers of the Ethylic Series.—G. Hinrichs.—A physico-mathematical paper.

Ethylacetylen formed Synthetically, and on its Identity with Crotonylen.—L. Pruner.—Ethylacetylen has been formed synthetically by Berthelot, who caused acetylen to act directly upon ethylen at a dull red heat. Crotonylen was discovered by Caventon, who removed 2 equivalents of hydrobromic acid from the bromide of butylen. The mixture of ethylene and acetylene was passed into bottles containing bromine. The bromised liquids, being left for two days in contact with a slight excess of bromide, are passed into tetrabromide, $\text{C}_4\text{H}_6\text{Br}_4$. On expelling the alcohol and crystallising, the compound thus obtained was found to agree in appearance, in properties, and especially in point of fusion with, the tetrabromide of crotonylen described by Caventon.

Synthesis of Phenylallyl.—C. Chojnacki.—The author obtained phenylallyl by heating to 100° under pressure a mixture of equal parts of benzil, and of iodide or bromide of allyl with one-fifth of zinc-powder.

Combinations of Chloride of Titanium with the Ethers.—E. Demarcay.—The author has formed and examined a number of these compounds, which he considers as chlorhydrines analogous to the silicic chlorhydrines of Friedel united to chlorides of the acid radicals. The sulphides and sulphhydrates of the alcohol radicals

behave with chloride of titanium in the same manner as normal ether.

On Phenolcyanine.—T. L. Phipson.—(see xxvii., p. 299.)

Remarks on Mène's Observations on the Manufacture of Sulphate of Ammonia from Nitrogenous Refuse.—L. L'Hôte.—The process for manufacturing ammoniacal salts patented by Martin, and which Mène pronounces impracticable, consists essentially in the substitution of lime, baryta, &c. for soda-lime. In some cases caustic soda alone is required. The azotised matter is first attacked with caustic soda-lye at 70 per cent, and the mass is afterwards made into a paste with slaked lime. On distillation the combustion of the organic matter is as complete as in the determination of nitrogen by the soda-lime process, and the residue contains neither nitrogenous charcoal nor cyanides.

Determination of Phosphoric Acid in Manures, Coprolites, Phosphatic Minerals, &c.—Ch. Mène.—A critique on the process of Joule (*CHEMICAL NEWS*, xxvii. 228, 309, 314). The citrate of ammonia process consists in treating the manure with dilute nitric or hydrochloric acid, and filtering off the insoluble matter. To the clear filtrate is added ammonia, which generally forms an abundant white precipitate. Citric acid is then added till the precipitate re-dissolves, and any insoluble particles are removed by filtration. To the filtrate is added sulphate of magnesia, and then more ammonia. The resulting precipitate is regarded as ammonia, magnesian phosphate, &c., is filtered, washed, and calcined. Without wishing to show how this analysis is faulty, the author insists, on the one hand, on the solubility of ammonia magnesian phosphate in ammoniacal salts, and, on the other, on the precipitation of all the gelatinous silica, which is then estimated as ammonia magnesian phosphate. To be convinced of this it suffices to take a few drops of silicate of soda diluted with water, to add ammonia which gives a precipitate soluble in citric acid, but capable of being precipitated afresh by ammonia. Alumina under the same conditions is not re-precipitated. To give an idea of the error which may be committed Mène quotes the results of an experiment when a fossil phosphate, by the citrate of ammonia process, gave 70 per cent tribasic phosphate of lime, but by Chancel's method—the bismuth process—it yielded only 1.5 per cent. The author agrees with Joule in his condemnation of the ammonia process (Bobbier's) but recommends in its stead that of Chancel, which he himself has used for ten years, and which is exempt from all errors in excess. (We think it deplorable if any analytical chemist is ignorant of the means for rendering gelatinous silica insoluble in dilute acids, thus avoiding the error in excess pointed out by M. Mène).

Bibasic Sulphate of Lead from Ariège.—Ed. Jannettaz.—The author finds this mineral identical with the bibasic sulphate of Leadhills. He remarks as a strange circumstance that the specimens of Lanarkite examined by Thomson and Brooke should, according to both these authorities, contain a half equivalent of carbonic acid, and should yet agree in their characters with the crystals from Ariège and Leadhills, which contain none.

Extract from Memoir on the Various Causes which Produce Strokes of Lightning.—M. de Fonvielle.—The author seeks to show that two neighbouring conducting objects react powerfully on each other under the influence of a thunder-cloud, and that this reciprocal influence varies according as they are insulated or connected one or other, or both, with the common reservoir; also that a thunder-cloud produces, by the fact of its movement, special reactions—like the plate of a Holtz machine. The induction on the earth's surface he points out must often be strong enough to affect the passage of clouds, giving them a greater velocity before they reach the zenith of the object electrified, or retarding them after they have passed the zenith; and this fact he compares with certain attractions and repulsions between stars, observed by

Hansteen and others, and doubtless due to magnetic force; which force appears to have been neglected as being in juxtaposition with that of gravitation: just as the displacement of clouds above referred to is combined with that produced by the wind. The changes in terrestrial magnetism in consequence of star motions are analogous to those which clouds produce in the electrification of the terrestrial surface.

Theory of Sun-Spots, and the Dark Nucleus of the Sun.—M. Vicaire.—This note refers chiefly to M. Respighi's observation of a sinking of the chromosphere at the spots. For this to yield valid support to the cyclonic theory, it must be shown (the author holds) that, supposing the depression certain, (and it has been contested by P. Secchi), it is really due to an engulfing of the chromosphere, and that a turning movement may be there observed; such movement being quite an exceptional phenomenon. Further, according to M. Faye's own calculations, the centrifugal acceleration in the solar cyclone would be only $\frac{1}{14}$ of what produces the terrestrial cyclone. Now the depression of the photosphere at the spots, and also, according to M. Respighi, that of the chromosphere, is equal to several thousand times that produced by terrestrial cyclones. Indeed, a fall of 4 c.c. in the barometric column corresponds at the sea-level to a displacement in altitude of 130 metres or $\frac{1}{11000}$ of the earth's radius, and it is known that there are solar spots the depth of which exceeds this radius. Hence the cause assigned for the spots by M. Faye would be only $\frac{1}{15000+181}$ or nearly $\frac{1}{2500000}$ of the intensity required by the phenomenon. M. Vicaire adheres to Wilson's theory of the sun's composition.

Researches of Spectral Analysis on the Subject of the Solar Spectrum.—Mr. J. N. Lockyer.—A recent communication to the Royal Society.

Reply to Preceding Note of M. Raynaud on the Maximum Resistances of Magnetic Coils.—M. du Moncel.

Relation between Electrical and Capillary Phenomena.—M. Lippmann.—When a drop of mercury in a glass vessel and, covered with sulphuric acid, is put in communication with a point of copper or iron passing through the acid, it suddenly becomes more convex, and an electric current is produced which polarises the surface. The surface contraction is due to a change of capillary constant; this and the electromotive force of polarisation are continual functions of each other. Reciprocally, an extension of surface produced mechanically polarises it as an electric current would. M. Lippmann varies the capillary constant of a surface of mercury in a glass tube, by polarising it with a current from a Daniell element, causing a deformation of the meniscus. He constructs a very sensitive capillary electrometer (for measuring electromotive forces), consisting of a thin glass tube of mercury, which he puts under the object-glass of a microscope for observation of the meniscus as affected by the current. Replacing the pile in the above case by an electrometer or galvanometer, and displacing the mercury mechanically, it can be shown that the electromotive force is varied, the quantity of electricity being independent of the form of the surface, and simply proportional to the area. He also constructs an electro-capillary motor. Two masses of mercury in acidulated water serve alternately as negative electrodes to the current of a Daniell element. In each mass are partially immersed a set of glass tubes open at both ends. At each inversion of the current one set rises, the other descends, and this alternate movement is transformed, by levers, &c., into one of rotation.

Magnetic Observations.—M. Diamilla Müller.—The author has established a temporary magnetic observatory on a hill near Florence, and shortly before the recent eclipse he noticed a stoppage for three quarters of an hour, of the oscillations in his magnetometer (which took on an average twenty seconds), and when they resumed they were much smaller and slower. He thinks this may be due to the special position of sun, moon, and earth, and

not to the eclipse; but invites observation of the oscillations of the needle at the approach of each new moon. He also gives results of the second series of simultaneous magnetic observations made in various parts of the globe on October 15 last. It appears—(1) That the secular variation of the declination is inversely proportional to the distance of the place of observation from the magnetic equator; (2) that the secular variation of the inclination is proportional to the extent of their magnetic parallels; (3) that the secular variation of the intensity (total force) is proportional to the secular variation of the inclination.

Spectroscopic Researches on the Fumeroles of the Eruption of Vesuvius in April, 1872, and Actual State of the Volcanos.—Extract from letter of M. Palmieri's to M. Sainte-Claire Deville.—The writer states that Vesuvius has become very quiet; and that he has found thallium in most of the fumerole sublimations (by spectral analysis) and, in some cases, a product rare in Vesuvius, viz., boric acid.

Reimann's Fürber Zeitung, No. 21, 1873.

On Petroleum Benzin.—The author describes the petroleum benzin now coming into use as a substitute for benzol. The new fluid is equally useful for dissolving oil fatty and resinous matters, but cannot be used in the manufacture of aniline.

Dyes for Wool.—Receipts are given for a sulphur fast puce, a fast drab, sad green with vat-blue bottom, fast violet with vat-blue and grain, madder drab, dark green, madder ponceau topped with grain.

Alpaca.—Silver grey and brown.

Dyes for Cotton.—The editor gives formulæ for a dull yellowish green, a cinnamon-brown, and a light brown.

Straw Hats with Aniline Colours.—The editor directs that if an aniline colour does not take on from a lukewarm solution, the straw-ware should be steeped in a hot solution of glue, then wiped with a cloth, and placed in the colour-bath.

Manufacture of Magenta without Arsenic.—Meister Lucius, and Co., of Höchst-on-the-Main, are manufacturing magenta by the action of nitro-benzol upon aniline or toluidine. Couper maintains that he patented as early as 1866 a process essentially the same.

Oil Colours for Printing.—The following mixture has been recently patented:—13 parts of varnish (what kind?), 5 of oil of turpentine, 1 of white wax, 1 of rosin or, instead, hotted linseed oil, 1 of half-boiled linseed oil, 0.20 of wax (?), 1.98 crude turpentine. Silk, woollen, and cotton tissues can be printed with this composition, and the colours do not wash off.

Annalen der Chemie und Pharmacie, band clxvii., hefts 2 and 3. (Neue Reihe, band xci., 2 and 3.)

On Phenanthren.—M. Hayduck.—Phenanthren crystallises in colourless, shining, occasionally rather large, crystalline scales; melts at 96°, begins to sublime at 100°, and passes over unchanged at higher temperatures. It is readily soluble in hot, and moderately in cold alcohol; and dissolves easily in ether, benzol, bisulphide of carbon, and glacial acetic acid. The solutions display a fine blue fluorescence. It dissolves with a green colour in concentrated sulphuric, and also in nitric acid. Ostermeyer and Graebe have observed that a sulphacid and a nitro compound are formed under these circumstances. A hydride of phenanthren is not formed even on the prolonged action of sodium amalgam upon the alcoholic solution. Its formula is $C_{14}H_{10}$, and its composition is as follows:—Carbon, 94.4; hydrogen, 5.6; total, 100.0. The author has examined the picrate—phenanthren dibromide, $C_{14}H_{10}Br_2$; bromphenanthren, $C_{14}H_9Br$; dibromphenanthren, $C_{14}H_8Br_2$; tribromphenanthren, $C_{14}H_7Br_3$; the chinoxin, $C_{14}H_9O_2$; and the dibromchinoxin, $C_{14}H_7Br_2O_2$. From this compound the author attempted, though unsuccessfully, to obtain an isomer of alizarin.

On the Compound $C_{12}H_8S_2$.—C. Paulz.—An account of the preparation, properties, and combinations of this as yet unnamed substance.

On Chlorosulphides of Carbon.—B. Rathke.—A lengthy paper, which does not readily admit of abstraction. **Action of Amides upon $CSCl_4$ and CCl_4 .**—B. Rathke.—Also unsuitable for abstraction.

Transformation of Nitric Compounds into Sulfonyl Acids.—B. Rathke.—On the prolonged digestion of nitroformendialliphon potassium, $CH(NO_2)(SO_3K)_2$, in the water-bath the quantity of the salt decreases, and a salt is obtained which does not contain the nitro group. This new salt has the composition of formetrisulphon potassium, $CH(SO_3K)_3 + H_2O$.

Researches on the Allyl Group; on β -Bromopropionic Acid.—G. Münder and B. Tollens.—A long and exhaustive paper not adapted for abstraction.

Transformation of β -Bromopropionic Acid into Acrylic Acid.—W. Caspary and B. Tollens.—The authors have prepared and examined the acrylates of silver, lime, strontia, and acrylic methyl-, ethyl-, and allyl-ethers.

Constitution of the Allyl- and Acryl-Derivatives.—B. Tollens.—A lengthy theoretical paper.

On Articles of Diet in General, and on the Value of Liebig's Extract of Meat as a Constituent of Human Food.—Max von Pettenkofer.—An important communication, to which we shall return on a future occasion.

Dry Distillation of Formiate of Lime.—A. Lieben and E. Paterno.—The principal product obtained is methylic alcohol.

On Paralactic Acid, the Optically-Active Lactic Acid of Flesh.—J. Wislicenus.—A valuable and exhaustive paper.

Supplement to Researches on Certain New Derivatives of Sulpho-Carbaminic Acid.—MM. Hlasiwetz and Kachler.—The authors find that their results had been anticipated by Zeise as far back as 1842.

Spontaneous Combustion of Hay.—H. Ranke.—The author finds that, in consequence of prolonged fermentation, hay can become transformed into a true coal, which, when exposed to the air at somewhat elevated temperatures, acts as a pyrophorus.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, No. 247, July, 1873.

Note on Rich and Pure Ores of Iron found in France.—M. Gruner.—The author points out various localities in France where brown hematite, manganiferous spathic iron, oligistic iron ore, and pure magnetic oxide are found in quantity.

Granier's Apparatus for Testing the Inflammability of Petroleum Oils destined for Lighting Purposes.—Report by V. de Luyne.—A small cylindrical receiver, of metal, is closed by a movable lid, provided with a circular aperture in its centre. This receiver is filled to two-thirds its volume of the oil to be tested, so that there remains between the lid and the surface of the oil a space full of air, with which the inflammable vapours furnished by the oil may mingle. A tube, soldered to the bottom of the receiver, holds a wick, whose upper extremity is in the middle of the aperture in the lid, whilst a thermometer plunged in the oil gives its temperature. To make a test, the oil is poured into the receiver to the height required; the wick is saturated with it, and lighted. The oil of the wick, burning, heats the oil till the temperature is reached, when inflammable vapours are given off. A slight explosion then ensues; the wick is extinguished, and the degree on the thermometer is read off. Petroleum-oils sold for lighting purposes in France are required to be colourless, to weigh 800 grms. per litre, and not to inflame at temperatures below 35°.

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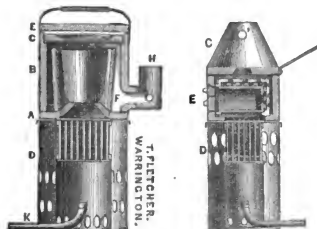
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THE CHEMICAL NEWS.

VOL. XXVIII. No. 711.

ON A

CURIOUS REACTION OF BENZOIC, SALICYLIC, AND HIPPURIC ACIDS.

By T. L. PHIPSON, Ph.D., F.C.S.

WHEN benzoic acid and glucose, in the proportions of about 3 eqivs. of the former to 1 equiv. of the latter, are mixed with a large excess of monohydrated sulphuric acid, and the mixture is slightly warmed, a fine blood-red colour is developed, very similar to that produced when salicin or willow-bark are touched with concentrated sulphuric acid. After a while the mixture becomes brown, and then blackens. Benzoic acid alone does not produce this reaction. It matters little whether the glucose is artificial or natural.

Salicylic acid, with glucose, treated in the same manner, presents the same reaction in a still more decided manner.

Hippuric acid, with glucose and sulphuric acid, gives first a clear brown mixture, in which also the blood-red colour soon develops itself; then the whole mass becomes black, and evolves a large quantity of an odourless and colourless gas. This gas is not absorbed by water nor by potash, and is inflammable, burning with a blue flame: I conclude that it is chiefly oxide of carbon. As the reaction continues from this time, after the source of heat is withdrawn, the mixture soon becomes very hot, and then sulphurous acid is given off also.

PRELIMINARY NOTE ON THE REDUCTION OF SULPHURIC ACID BY HYDROGEN.

By G. J. WARNER, F.C.S.

FOR several years past I have used a method to avoid percussive ebullition in distillation, which I have found very satisfactory, viz., that of passing through the liquid in the retort a slow current of some inert gas which is easy of preparation. Dry air, carbonic acid, and hydrogen are those most generally applicable.

I had frequently distilled sulphuric acid in a current of air which had been previously dried over calcium chloride, but on using hydrogen I find that a large quantity of sulphurous acid is always evolved.

This reaction appears to commence at about 160° C., and the quantity of sulphurous acid formed increases with the temperature, but at no point was the decomposition complete. At temperatures near the boiling-point sulphuric acid always distilled over unchanged.

Fearing that the reduction might arise from the presence of hydrogen sulphide in the hydrogen, produced by sulphurous acid in the acid used for its preparation, I passed the gas first through a solution of lead acetate, and then over calcium chloride, when the same reaction ensued, although the lead solution was not blackened. Every precaution was taken to avoid the contact of cork or india-rubber with the acid vapour, the hydrogen being passed through a glass tube ground into the neck of the retort.

In some measure to confirm this reaction, I heated (1) distilled sulphuric acid in an atmosphere of hydrogen, in a sealed tube, for twelve hours, at a temperature of 205° C.: when broken, a quantity of sulphurous acid was found in the tube in the gaseous state. (2) Two similar tubes, containing the same acid in air, heated at the same time to 205° C., contained, when opened, no sulphurous acid. (3) A sealed tube, containing hydro-potassic sul-

phate fused and filled with hydrogen, was likewise heated to 205° C. for twelve hours: a quantity of sulphurous acid was formed. (4) Two similar tubes, containing the same salt in "air," contained no sulphurous acid. (5) With dried ferrous sulphate, similarly treated, no sulphurous acid was produced at that temperature.

I intend to pursue this subject further, and to investigate the effect of nascent hydrogen on sulphuric acid of various densities, at the temperatures of their boiling-points.

This will, I expect, afford an explanation of the fact that sulphuric acid, even containing a considerable proportion of water, yields, when heated to the boiling-point with zinc, not hydrogen, but sulphurous acid.

NOTE ON THE NESSLER TEST.

By J. ALFRED WANKLYN.

IN the course of the various controversies relating to the water process frequent mention has been made of the time required for the development of the Nessler colour. According to some experimenters, a few minutes suffice for the full colouration; according to others, half an hour or more is necessary.

These differences have their origin in differences in the quality of the Nessler reagent. I have known two Nessler reagents which, although in the course of hours giving the same depths of colour with the same quantity of ammonia, required very different times for the production of the colouration. One sample of Nessler reagent gives its maximum of colour almost immediately, and another sample takes a quarter of an hour or an hour for full development.

To a great extent, these differences depend upon whether or not a sufficient quantity of solution of corrosive sublimate has been added to the finished Nessler reagents. Whether the *Nesslerising* takes a couple of minutes, or whether it takes an hour, is a matter of vital importance to those persons who are working the ammonia process of water analysis; and since the employment of the ammonia process has become almost universal, I have deemed it to be worth while to direct attention to the necessity of a careful preparation of the Nessler reagent. I have, moreover, made arrangements with Messrs. Townson and Mercer for the supply of *quick* Nessler reagent at the rate of twenty shillings per litre. Those chemist, who do not feel disposed to take the trouble of making the reagent themselves have now the opportunity of buying it

NOTES ON THE ANALYSIS OF ANIMAL CHARCOAL.

By JAMES M. MILNE, Ph.D.

Two papers on the above subject have recently appeared in the *CHEMICAL NEWS*, viz., one by Mr. T. L. Paterson (vol. xxvii., p. 111), and a short review of the same by Mr. A. S. Wilson (vol. xxvii., p. 225). A somewhat lengthy discussion on the same subject has also been carried on, in the pages of the "*Greenock Sugar Trade Review*," between Mr. Paterson and Mr. Murphy, of Liverpool, the practical results of which seem somewhat small when compared with the amount of noise made. Some of the statements made are, to say the least of it, rather novel; but it is a pity that a scientific discussion should be allowed to degenerate into mere personal wrangling, not to speak of doggerel rhymes.

With the view of satisfying myself as to the accuracy of some of the points in dispute, I have recently made a considerable number of experiments. These have been more especially directed to the determination of the moisture in samples of new char, and the presence of organic matter soluble in water.

In one of his replies to Mr. Paterson, Mr. Murphy makes the somewhat startling announcement that water with which new char has been treated is *strongly alkaline*, and will therefore dissolve appreciable quantities of organic matter from a paper filter. He thus accounts for the soluble organic matter found by Mr. Paterson in his experiments. I must confess that I, for one, have yet to learn that the water from new char is *strongly alkaline*, much more that it will dissolve filter-paper. In order to set aside all doubt on the subject, however, the following experiment was made:—5 grms. of a sample of new char were treated with water, and the liquid filtered without the use of paper, the neck of the funnel being stopped with recently ignited asbestos. The filtrate, which was quite colourless, and only very feebly alkaline, was carefully evaporated to dryness in a weighed platinum basin; the residue dried at 130° C., weighed, and cautiously ignited. The contents of the basin blackened quite perceptibly; and on the ignition being completed, and the capsule weighed, the loss was found to be 0.112 per cent—a result corresponding very closely with that given by Mr. Paterson in his paper.

Although the moisture in samples of old or used char can be correctly determined at 212° F., it is well known that this temperature is quite inadequate for the expulsion of the whole of the water from new char. In his instructions for the analysis of bone-black, Fresenius gives 160° to 180° C. (320° F. to 356° F.) as the temperature at which the moisture should be estimated. A few years ago Dr. Wallace, in a paper on "Animal Charcoal," gave it as his opinion that a temperature of not less than 350° F. was necessary. Mr. Paterson, however, considers 350° F. much too high, and sufficient to destroy a portion of the organic matter. He considers that five hours in the water-bath at 212° F. is all that is necessary, and asserts that char, during the process of pounding, always loses water. Now, while it is quite possible that long-continued grinding in a warm atmosphere may have that effect, it is difficult to understand how a porous substance like charcoal, which retains water somewhat persistently, should lose some of it, during the short time necessary for reducing it to powder. On the contrary, we should rather expect a slight increase. That this is really the case, the results of Mr. Wilson's experiments, as well as my own, seem to demonstrate. The following experiments were made with reference to this part of the subject:—


A.—(1). A sample of new char was taken, and one-half reduced to powder; both were placed in tightly-corked bottles; 2 grms. of each were weighed out and kept in the water-bath, under precisely similar conditions. The loss of weight was as follows:—

	Unground.	Ground.
After 1 hour ..	4.67 per cent.	4.92 per cent.
" 3 hours ..	4.85 "	5.09 "
" 5 " ..	there was no further loss in either case.	

(2). 1.2802 grms. of the same sample was heated in an ordinary air-bath, at different temperatures, as under:—

	Unground.	Ground.
At 350° F. for 15 minutes the loss was 6.11 per cent.		
" 400° " 10 m. longer ..	" 6.98 "	" 6.86 "
" 450° " 10 " ..	" 7.36 "	" 7.36 "
" 500° " 10 " ..	" 7.36 "	" 7.36 "

(3). 2 grms. of the sample were placed in a platinum-boat, and introduced into a glass tube about 9 inches long. The tube was then placed in an air-bath, made for the purpose, and one end attached to an apparatus for drying the air previous to entering the tube. To the other end a weighed chloride of calcium tube was attached, and this again was placed in communication with one arm of a Staedler's aspirator, by means of which a uniform and well-regulated current of dry air could always be obtained. The air-bath was heated by a small Bunsen, the temperature being registered by a thermometer passed

through the lid. For temperatures not over 350° F. a glass tube of this form  is useful, the thermometer being passed through a cork, but for higher temperatures a plain tube is to be preferred.

A great number of experiments were made with this apparatus, in order to determine the water by direct weighing, some of the results of which are given below.

Two grms. heated in the air-current—

	Unground.	Ground.
At 350° F. for 15 minutes gave 6.50 per cent.		6.52 per cent.
" 450° " 10 m. longer ..	7.01 "	7.07 "
" 500° " 10 " ..	7.17 "	7.19 "

B.—(1). Another sample of new char (foreign) was subjected to the same mode of treatment.

Two grms. of the unground sample placed in the water-bath lost—

In 1 hour ..	3.23 per cent.
" 2 hours ..	3.29 "
" 4 " ..	3.31 "
" 5 " ..	3.38 "

After 5 hours there was no further loss.

(2). The same quantity was placed in the air-bath.

At 250° F. for 15 minutes the loss was 3.92 per cent.

" 350° " 30 " ..	4.51 "
" 450° " 30 " ..	5.01 "
" 500° " 30 " ..	5.22 "

		Per cent.
2 grms. heated directly to 500° F. for 20 minutes	lost 5.43	
" 500° " 20 "	5.08	
" 500° " 10 m. longer	5.28	

(3). Two grms. treated in air-current—

At 250° F. for 15 minutes gave 4.17 per cent.

" 350° " 15 m. longer ..	4.62 "
" 525° " 5 " ..	5.32 "

Two grms.—

At 350° F. for 15 minutes gave 4.61 per cent.

" 450° " 10 m. longer ..	4.81 "
" 500° " 5 " ..	4.92 "

Two grms.—

At 450° F. for 30 minutes gave 5.03 per cent.

Two grms.—

At 450° F. for 20 minutes gave 5.24 per cent.	
" 500° " 15 m. longer ..	5.29 "

Two grms. were taken as before, but in this case the loss of weight was also found by weighing the residue in the boat, which was placed in a closed tube.

	Gain in CaCl ₂ Tube.	Loss from Residue.
At 500° F. for 10 min.	5.40 per cent.	6.63 per cent.
" 500° " 15 " ..	5.47 "	6.63 "
" 500° " 20 " ..	5.55 "	6.98 "
" 525° " 5 m. longer	5.65 "	7.22 "

Two grms.—

At 500° F. for 20 min.	5.35 "	6.03 "
" 500° " 30 " ..	5.37 "	6.21 "

From an examination of the above results we are justified in concluding—

1. That the water in a sample of new char is sensibly increased by the process of pounding, instead of being diminished.
2. That a temperature of 212° F. is quite inadequate for the determination of the water in such samples.
3. That there is a loss on heating in the air-bath up to 500° F., and that, if heated in the air-current, there is a gain in a CaCl₂ tube up to that temperature, showing that even at 350° F. the water is not completely expelled.

The determination of the water by *direct* weighing is, of course, to be preferred to the ordinary air-bath, which at the higher temperatures usually gives too high results. The difference between the gain in the CaCl_2 tube and the loss from the residual char shows that the loss of weight is not entirely water. I would recommend heating in the air-current for, say, 30 minutes, as giving reliable results.

Chemical Laboratory,
107, Bath Street, Glasgow.

ON THE ACTION OF WATER ON LEAD.

By Sir ROBERT CHRISTISON, Bart.

THE most general results of the author's former inquiries are—1. That the purest waters act the most powerfully on lead, corroding it, and forming a carbonate of peculiar and uniform composition. 2. That all salts impede this action, and may prevent it altogether, some of them when in extremely minute proportions. 3. That the proportion of each salt required to prevent action is nearly in the inverse ratio of the solubility of the compound which its acid forms with the oxide of lead.

The effect of certain inorganic and organic ingredients of water in modifying the preservative power of the salts the author did not investigate. This has been made the subject of numerous inquiries and observations by others, chiefly, however, of a desultory nature, some of them too much succinctly described, and some, also, of questionable accuracy.

It has been denied that water acts by reason and in the ratio of its purity; and it has even been alleged that distilled water itself does not act if really quite pure. The author has, however, invariably found the reverse to be the case, and can assign no other explanation of these statements, except some error in manipulation. For example, a very pure spring water was sent to him from the south of England, with the assurance that it had been found incapable of attacking lead; but, on making trial of it, he found it to act with an energy not inferior to that of distilled water.

It has also been stated that ordinary distilled water is apt to contain a trace of nitric or nitrous acid, from nitrates incidentally present in the water subjected to distillation; and that such water, if distilled after the addition of a little potash to fix the acid thoroughly, yields a distillate which has no action upon lead. But when the author prepared distilled water in this way, with great care to prevent the access of impurities from other sources, the only result was that the action was even stronger than that of the ordinary distilled water of the laboratory, and greater, indeed, than he had ever before observed.

An interesting statement has been made by Dr. Nevins, to the effect that some salts appear to allow of a certain action going on when they are present in water largely, although their influence when they exist in very small quantities is to act as preventives. This result the author has sometimes obtained, and has found the action such as might prove dangerous. But its limit requires to be defined; and there is reason to suppose that the proportion required to permit action will be found to be greater than is ever likely to occur in the instance of waters applicable to household use.

It has also been said, but in general terms and without experimental proof, that the presence of carbonate of soda, even in a hard water, takes away the preventive influence of the other salts, and enables the water to dissolve lead. There appears to be some foundation for this statement; but here, too, it is necessary to fix what is the limit to such influence before its importance can be valued. Moreover, as bicarbonate of soda appears to have no such effect, and this is the usual form of the car-

bonate in natural waters, the practical importance of the fact is inconsiderable.

The corrosive action of water upon lead has often been confounded with other causes of corrosion, and the water has borne the blame. Thus the true action has been confounded with the corrosive action of potent agents accidentally coming in contact with the metal in the presence of water, as, for example, when a lead pipe has been led through fresh mortar, which is frequently or permanently kept moist, or when lumps of fresh mortar have been allowed to fall upon the bottom of a lead cistern.

The true or simple action of water has not unfrequently been confounded also with the effects of galvanic action. Thus, if a lead pipe or cistern be soldered with pewter solder and not with lead, erosion takes place near the line of junction of the solder with the lead. The presence of bars of other metals crossing lead, or bits of them lying on it, will also develop the same action; and some facts seem to point to the same property being possessed in a minor degree by some stony and earthy substances. This observation may explain the local erosion sometimes observed in cisterns containing hard water; since, if galvanic action be excited, it will be increased by the fact of saline matter existing more largely in these waters than in soft or comparatively pure water.

Lastly, some observers have contradicted former statements, because under certain circumstances, which led them to anticipate no action, they nevertheless found lead in water, but only in extremely minute and unimportant proportion. The test for lead, hydrosulphuric acid, when employed in the way now usually practised is so delicate as to detect that metal when dissolved in ten million parts of water, or even more. Facts, however, warrant the conclusion that the impregnation must amount to at least ten times this quantity before water can act injuriously on man, however long it may be used.—Iron.

ON THE ENERGIES OF THE IMPONDERABLES, WITH ESPECIAL REFERENCE TO THE MEASUREMENT AND UTILISATION OF THEM.*

By the Rev. ARTHUR RIGG, M.A.

(Continued from p. 7).

MAN need but watch the progress of science-truths for a few years, or read the development, stage by stage, of any branch of investigation, to be satisfied of this, that, with whatever pertinacity and show of reasoning any theory is propounded and established, it rapidly wanes, and again have they been satisfactorily (?) explained, and yet how soon and how rapidly has one explanation been so crushed out by another, that the first, which by its authors was applauded, is by the upholders of the second ridiculed.

The theories of the imponderables, with which we must occasionally deal or allude to, but with which we are in no degree further concerned, are, day by day, in a transition state. Like the cause of solar heat, or the rotation of the moon, they are a bloodless battle-field, on which, with our increasing love of talking and our decreasing love of working, words may war with words.

A triumphant victory to-day in science theory may be the prelude to an ignominious defeat of the same theory to-morrow. Subject, doubtless, to many dissentient views, the belief that he who propounds theory, and uses theories solely as means or ways by which to convey ideas of how such and such facts may perhaps be brought about, and not as expressing a conviction that the way described is the actual plan in operation, he is the truly wise man. Those who allow themselves to dwell upon the conception

* The Cantor Lectures, delivered before the Society of Arts.

and the development of theories, who build theory upon theory, who sometimes pile Ossa upon Pelion, and sometimes Pelion upon Ossa, are not unlike those whom Milton describes—

"Who reasoned high
Of providence, foreknowledge, will, and fate,
Fixed fate, free will, foreknowledge absolute,
And found no end, in wandering mazes lost."

Thus it is that the decisions of one age and one day differ from those of another age and another day. Theories, we must remember, are but opinions; with opinions, as such, this course of lectures is not concerned. The facts of Nature, so far as they have yet been made apparent, or may be in process of being so, are our province. They change not. To those who have appealed to Nature direct, and brought from her exhaustless stores of knowledge some truths that men may utilise, is due the information which is to be brought before you.

The mode by which they have won this knowledge is exactly that pursued in our courts of law and equity, to arrive at the truth on one point, and on one point only. Look how long and tedious legal investigations seem, and yet in how few words the result is declared. Guilty or not guilty—Verdict for the plaintiff or verdict for the defendant. One or other of these very brief phrases records the conclusion or the judgment of many days of patient labours and searchings for truths.

To not less careful questioning by men in years past, as well as now current, we owe all we know of the energies, the measurement and utilisation of which is to be a feature in these lectures. That cross-questioning of the keenest and clearest kind has been essential may be inferred from the fact that these energies are so co-related—so mutually convertible—that they merge and change, Protean-like, one into the other so instantaneously that no one energy can be conveniently retained alone and in operation. They thus pass and interchange without (to our eyes) a signal from any magician's wand.

The transmutation of the imponderables are accomplished in a way that would have gladdened the eyes of the most profound alchemist, could he have seen as great transmutations in some of the material things in which he worked. For example, whenever energy is lost by resistance, heat is produced, *i.e.*, when the resistance is perfect and complete, admitting of no intermediate state; *e.g.*, if a wheel in machinery does not move easily, the consequence is heat, manifested on the shaft.

If, however, that energy can be converted into an intermediate state, then this state may be assumed—much as light from gas is an intermediate state between chemical affinity and heat. Do what we may, that from which energy results can neither be created nor destroyed.

In the case of blows by impact, as in the tongue of a bell, or the hammer on an anvil, or a clock, or a piano, or on a drum-head, or on a gong, then, whilst doubtless some part of this checked energy is converted into heat, yet a large portion is spent in the production of vibrations in matter, appreciable to our senses, and suggestive of vibrations in molecules, which our senses, aided by physical appliances, have not yet made visible, but which chemical changes, and what to the minds of science theorists of the present day is conclusive evidence, seem to point as similar vibrations in the invisible molecules and atoms of which it is assumed that bodies consist.

These remarks may suffice to explain that whilst to speak of estimating an "energy" is easy, yet to estimate that "energy" is an employment which tasks the keenest and most watchful faculties of the human mind, as well as claiming from human hands the production of some of their most exquisite and refined work.

The difficulty of the task results not so much from a solution of the simple problem which the words "estimate that energy" convey, as from the incompetence alluded to of isolating and continuing the special energy and noting its operation. For no one of nature's energies,

be they ponderable or imponderable, is alone. Solitariness in the unseen, as well as in the seen, is no part of nature's plans.

Faraday seemed to have realised this view in great intensity when he wrote—"If, as I believe, dualities are essential to the forces, are always equal, are mutually dependent, that one cannot appear or exist without the other: the proof of this would lead to many consequences of high importance to the philosophy of force generally."

This interlacing of energies,—this co-relation, as it is called, of physical forces,—whilst it knits in harmonious union energies which are nominally distinct, baffles the investigator who wishes to assign to each its share in any specific work. For example, the energy of gravity operates everywhere, and our fundamental principle in hydraulics, that fluids press equally in all directions, may be granted as a postulate. The experiments by which it can be confirmed may be and is very clearly described, but no one has ever made or can make them. Gravity never ceases to impress upon fluids a downward tendency, and so prevents an equality of pressures in all directions being established.

It may be in the interest of the Moslem faith to assert that, without visible means, Mahomet's coffin rests between earth and heaven; but, assuming the truth of the tradition, or of the fact (whichever it be), we know well that gravity operates in all its wonted intensity, and that the coffin is held there (if held at all) by the introduction of some counteracting energy, as that of magnetism.

The energy of electricity is ever passing into heat—that of heat into electricity or light. Electricity, again, appears to assume the form of vitality; and then, again, it totally fails to fulfil the vital conditions. In some animals the exhaustion of their muscular energy is consequent upon the exhaustion of their vital energy, and no electrical appliance can restore the vital energy, even though it seems to restore the muscular. Take affinity. This passes, by means unknown to us, into electricity and heat.

There is also this peculiarity amongst these energies. The work of one energy, estimated by any means known to us, gives no indication of the work of some other energy, resident or potential, in the same matter.

For example, the estimation of a drop of water by gravity standards—to speak of it as weighing so many grains—gives no indication whatever of its ability to promote affinities, to absorb and convey heat, to decompose light. And if even all these were known, there would still be no indication that upon an electrical standard of measurement its destructive effects are equal to that of a flash of lightning.

The only energies that may be said to be non-interchangeable are those of gravity and vitality. The former is enduring, the latter fleeting. The character of the one is persistence and constancy; that of the other, change and variety. Gravity may be said to be quietly resident in matter; vitality shows its presence by growth or motion.

Gravity is an energy pervading all nature, as intense in grains of sand as in the mountain; in a drop of water as in the river or the ocean. Disregarding alike the vitality of the plant or the animal—for gravity treats them as though they were as inert, indifferent, and unconscious of its presence as the soil of the garden, or the mineral under the earth—thus this energy, which is to occupy our chief consideration in the next lecture, is alone, and yet we shall find how that it has been left for recent times to tabulate its measure, to report and utilise, under the guidance of ordinary arithmetical and mathematical rules, the scientific and social consequences of the measure so established.

The other energy, that of vitality, which is to occupy

our attention in a future lecture, can hardly as yet be said to have been measured. The time, however, is very near when the hope will be realised; that the energy of vitality—the mechanical, the statical, dynamical, and absolute energy, of course, is meant—may be reduced to as exact a science as those of light, heat, and electricity have recently been.

All who have questioned Nature are well aware how simply and truthfully she replies. It must, however, be steadily borne in mind that this truthfulness applies to the question and answer in their mutual relations. If the question be so put that Dame Nature has to answer in respect to the combination of two elements, and so is called upon to give a reply which is in truth the aggregate of the two, she does so. It behoves the questioner to frame his question with the utmost care, in order to eliminate what is extraneous to his purpose. All must have observed how difficult it is to frame a question which cannot be mis-read, or admit of a reply evidently based upon a view which the questioner never contemplated. For example, if the question relates to gravity, caution is needed to exclude the buoyancy and even viscosity of the air, and the centrifugal effects of the earth's rotation.

If it relate to electricity, caution is needed to exclude the most infinitesimal alloy of a metal—even a metal itself.

If it relate to vitality, caution is needed to exclude the effects of temporary exhilaration or prostration.

If it relate to affinity, caution is needed to exclude the complication of phenomena by variations in gaseous pressure or atmospheric temperature.

If it relate to heat, caution is needed to exclude peculiarly constituted substances, in their unknown and varying effects on heat from their atomic or rather molecular condition.

Although, for purposes of classification and the general distinction of the phenomena, the energies found in nature are arranged under the general energies which are prefixed to the respective lectures of this course, yet it must be borne in mind that these are verbal rather than emphatically actual distinctions. They are merely the terms recognised at the present day, and in a few years may be dismissed. The convertibility of energy just now alluded to is a phrase which conveys a clear meaning, but this convertibility is a process that cannot be followed. At one time in the science world a general principle seems to have been established in relation to it; again and again the hope fades, the principle is on no secure basis, whilst the convertibility is ever active. It may not inappropriately be asked which energy is the source of the others—which, in fact, seems to have the highest claim to be classed as *the one*. Doubtless, as a question of sequence, in time gravity must claim the first place, but, so far as our powers of utilising the energies of the imponderables are concerned, we are not able to appeal very hopefully to gravity. We cannot obtain the other energies from it. Gravity refuses to be converted; its political principles are of the type which permits no change. Nature's No. 1 must be gravity; man's No. 1 affinity. For example, oxygen and hydrogen manifest their affinities in obedience to some inexplicable law. They enter into what is called combination, and in so doing manifest one form of energy to which the name of the "energy of affinity" is given. But in the transition state—in the act of obeying the very imperfectly known laws of affinity—another energy of a different name and character appears, viz., heat. Evidence of the power of this energy—heat—is furnished to tests very different to those which may be applied to the energy of affinity. The heat is presented to the thermo-electric pile, and that a great change in the mode of its energy has taken place is obvious from the results it produces at a distance; to this new form of energy we give the name of electricity. By a species of magic, electricity has called forth an energy to which is given the name of magnetism. Suitable circumstances

being presented to this new energy, there is a machine propelled and capable of doing mechanical work. We now call it mechanical energy.

Thus, by change superposed on change, the energy of an imponderable has been converted into that energy of the ponderable to which we are indebted for all, or nearly all, of arts, manufactures, and commerce.

The two imponderable energies into which chemical affinity cannot be converted are vitality and gravity. These two may, as we shall hereafter find, assume the form of the others—the others cannot assume their forms—at least not in any plain and honest sense. Except in these two physical energy is a visible reproduction of the invisible doings of chemical affinity.

Simple as this process of transformation may appear, and convenient and useful as the suddenness of the change may be, it cannot be denied that to the investigator it is perplexing. Men, however, labour on, each perhaps winning a little from the unknown, and adding it to the known. Thus, although "hills peep o'er hills, and Alps on Alps arise," yet men of varied resources and patient perseverance have won those invaluable treasures of measurement and utilisation from the imponderables and unseen which give the title to this course of *Cantor Lectures*.

Even Livingstone has not shown a more noble resolve "to conquer or to die" than have those to whom we are indebted for all we know touching the modes of measuring the energies of gravity, vitality, affinity, electricity, light, and heat.

As illustrations of the difficulties of the tasks before them, it may suffice, in this introductory stage, briefly to observe that:—

Galvanic currents may escape notice unless the intensity of terrestrial magnetism be neutralised.

Diamagnetism and the magneto-electric spark escape notice, unless a large number of galvanic cells or their equivalent is used.

What was called the "smell of electricity" led Schöenbein to the discovery of "ozone," a remarkable product, and one whose energies are yet unknown, although being slowly but surely developed.

That a vibrating magnetising needle came to rest sooner in the neighbourhood of a copper plate, now called a damper, then when the plate was away, led to the discovery of the induction of electric currents by Faraday.

Opinions from telescopic appearances of the size of the stars led to an idea that their discs differed; the phenomenon has been found to be due to the diffraction of light.

The velocity of sound was calculated, making due allowance for the direction of the wind; in recent years it has been found that the heat developed by one particle of air striking another, must be taken into account.

(To be continued.)

Royal School of Mines.—At a meeting of the Council, held on Saturday, July 5, the following gentlemen received the diploma of Associate of the Royal School of Mines:—Mining and Metallurgical Division—E. Jackson J. A. Griffiths, C. Law. Mining Division—A. G. Phillips. Metallurgical Division—J. W. Westmoreland, S. W. Davies, J. C. Jefferson, H. S. Bell. Geological Division—G. Smith. The following scholarships and prizes were awarded:—The two Royal scholarships of £15 each, for first year's students, to Mr. W. Carter and Mr. A. J. Meeze. For second year's students—His Royal Highness the Duke of Cornwall's scholarship of £30 for two years, to Mr. C. Lloyd Morgan; and the Royal scholarship of £25, to Mr. S. A. Hill. The Edward Forbes medal and prize of books, for natural history, to Mr. G. Smith. The De la Beche medal and prize of books, for mining, to Mr. Edgar Jackson. The Murchison medal and prize of books, for geology, to Mr. C. Lloyd Morgan.

CORRESPONDENCE.

ON A SYSTEMATIC MINERALOGICAL
NOMENCLATURE.

To the Editor of the Chemical News.

SIR,—As I see by your report last week of the meeting of the Chemical Society that Mr. Hannay has called attention to a new system of mineralogical nomenclature, I sincerely hope that this most important subject will not be allowed to fall to the ground until something has been done. No person will deny that the state of hopeless confusion into which the method of naming minerals has fallen is very injurious to the advance of the science, and there is nothing which would do more good to the science of mineralogy than the introduction of a real systematic method of naming the substances composing the crust of the earth. The present state of affairs makes a complete knowledge of mineralogy next to impossible, and the difficulty which beginners experience in gaining a knowledge of the properties and position of each mineral in relation to others (having no systematic name to guide them) is very great indeed. There has been an immense amount of work done in mineralogy, both in the chemical and physical constitution of the minerals; and this great body of work just requires one addition to bind together the scattered forces, and that addition is a systematic nomenclature. As chemists are by far the most influential body connected with this subject, I hope to see them take the matter up, and, by introducing a new system, set mineralogy on its feet.—I am, &c.,

R. W. EMERSON McIVOR.

Glasgow, July 1, 1873.

ON BUTTER.

To the Editor of the Chemical News.

SIR,—I was much pleased to find in the CHEMICAL NEWS (vol. xxviii., p. 1) a paper "On Butter," by Dr. Brown. May I suggest to you the great benefit to myself and others if you would continue such valuable papers? The Adulteration Act now in use would justify surely such articles, and would enable chemists in the provinces to see the means used for detection of adulterations by gentlemen whose skill as analysts is above any doubt. I am not aware of any work on adulterations except Dr. Hassall's, and that I think is much too prolix as a handbook, although very excellent in its way.—I am, &c.,

J. B.

ON BUTTER.

To the Editor of the Chemical News.

SIR,—The extraordinary paper which Dr. Campbell Brown publishes in the last number of the CHEMICAL NEWS calls for a few words of comment. Dr. Brown, who is a Doctor of Science of the London University, appears not to know that butter resembles suet, tallow, dripping, and lard by containing, as they do, stearin, olein, and palmitin; and that it differs from them only by containing these fats in different proportions, and by containing very small quantities of butyric acid.

His notion of looking for the milk globules in butter is very amusing, especially when it is borne in mind that butter is frequently raised to its melting-point either by accident or by design, and, according to good authority, is none the worse for the process.

The analytical operations which he recommends for the purpose of detecting adulteration of butter with foreign fats appear to me to be utterly delusive; they are on a par with the chemistry of the composition of butter.

Inasmuch as Dr. Brown occupies a responsible position,

being Public Analyst for Liverpool, Cheshire, and the Isle of Man, I have felt it my duty to make this protest against his methods of procedure.—I am, &c.,

J. ALFRED WANKLYN.

London, July 5, 1873.

NOTICES OF BOOKS.

Notes of a Course of Nineteen Lectures on Natural Philosophy. Delivered at Guy's Hospital during the session 1872-3. By G. F. RODWELL, F.R.A.S., F.C.S. London: J. and A. Churchill. 1873.

NOTES, summaries, or recapitulations are, when properly made and used, of great value to the student,—are, in fact, quite necessary if he has to pass through the ordeal of an examination. Nevertheless they are very dangerous and liable to much abuse by becoming elements of the machinery of cramming. Hence we open this book with a certain degree of suspicion, which is not diminished by the preface, wherein the omission of Acoustics and the comparatively slight treatment of Light is explained by the fact that the Lectures "had special reference to the requirements of the Preliminary Scientific (M.B.) Examination of the University of London." An abstract of lectures delivered with this avowed object necessarily treads on the frontiers of cram, and no small amount of skill is necessary to keep them from stepping across.

On further examination of Mr. Rodwell's Notes, we find that this difficulty is very skillfully mastered, and a really sound and useful abstract of the subject is given: the short propositions are by no means stated in a form that would serve to mechanically pack the memory with a series of mere answers to examiners' questions. Considering the small space into which the subjects are condensed, there is a very fair amount of logical sequence binding together the propositions, which for the most part are stated rationally rather than dogmatically. Anything like complete demonstration is, of course, impossible in the space of such notes, nor could it have been attempted in the full extension of merely nineteen lectures required to cover the subjects of the Statics and Dynamics of Solids, of Hydrostatics, Hydrodynamics, Pneumatics, Light, Heat, Magnetism, and Electricity. Thus limited, there was no need of the apology in the preface for subjects omitted. The apology should rather have been for the excessive quantity which the compulsory limitations of the teacher's time has forced him to include in so short a course.

This work displays a defect which is common to most of our modern elementary treatises, one which appears to be growing at a rate which threatens to seriously damage the educational value of physical science. We refer to the statement of hypotheses in such a manner that the pupil is likely to accept them as actual facts. This is especially displayed in the summary of the subject of heat. The following is an example:—"Since all matter possesses a certain amount of molecular motion, and no two molecules are in contact, it follows that all molecules possess a certain amount of potential energy, and that the acts of heating and cooling (addition and subtraction of molecular motion), may be expressed respectively as the increasing and the lessening of molecular potential energy, considered in regard to its amount at the time of such addition or subtraction."

Here, as in other propositions, the existence of molecules, of inter-molecular spaces, and of molecular motion are described in the same positive and unqualified terms as expansion or contraction, solidity or fluidity, and there is nothing to indicate the vast difference between the actual and demonstrable facts, and the figments of philosophical imagination. Even if this conception of the discrete molecular constitution of matter were universally accepted, it would be absolutely necessary to sound intellectual

discipline than the student, at the very outset of his barest rudimentary studies, should be taught that these molecules separated by interspaces through which they swing with varying range of motion, are purely poetical conceptions to be clearly distinguished from the positive physical facts which they have been invented to explain. The use of the imagination in science, and in all other comprehensive efforts of the human mind is, perhaps, as necessary as the use of the senses and the reasoning faculties, but to escape the erection of a whole fabric of rotten fallacies we must clearly distinguish between the facts of observation, the conclusions of reasoning, and the creations of imagination.

As already intimated, these strictures are not applied solely or especially to the work of Mr. Rodwell, but refer to a generally growing vice of elementary works on physical science. We have thrown overboard "the imponderables," and no longer talk with flippant familiarity of electric magnetic fluids or of caloric, and therein have acted wisely, but our progress will become a mere oscillation if we erect mathematical idols on their pedestals, and worship them with equally unreasoning blindness.

Having uttered this protest, we may, for the rest, strongly recommend these Notes to all who need the intellectual refreshment of a well-arranged and carefully-written condensation of the leading facts and principles of the chief elements of Natural Philosophy.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopaedic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgement. The two half-yearly volumes of the Chemical News, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, June 16, 1873.

Heat Liberated by the Combustion of Formic Acid.—M. Berthelot.—A thermo-chemical paper, bearing chiefly on the dispute pending between Favre and Silbermann on the one hand, and Thomsen on the other.

Alloys used for Gold Coinage.—E. Peligot.—Sugar-gestion on a uniform international monetary standard.

Report on Investigations relating to Phylloxera vastatrix.—MM. Duclaux, Cornu, and L. Faucon.—An enquiry into the ravages of a vine-destroying insect, along with an analysis of the roots of the vine.

Researches on the Essence of Alangilan (*Unona odoratissima*).—This essence, lately introduced into the market, commands the price of 2500 francs per kilog. It is extracted by distillation from the flower of a tree found in Jamaica. The specific gravity of the essence at 0°C is 0.950 . A column of 5 c.m. in depth deflects a ray of polarised light 14° to the left. It distils over entirely between the temperatures of 160° and 300° , without leaving a carbonaceous residue behind. It is insoluble in water, partially soluble in alcohol, and entirely soluble in ether. After partial saponification with potassa it yields benzoic acid.

Contributions to the History of the Histological Constitution and the Chemical Function of the "Glairine" of Molitz.—A. Béchamp.—Glairine is a deposit obtained from the sulphur-springs of Molitz. It consists chiefly of gelatinous silica, and, like the micro-

zymas of chalk and other calcareous formations, is capable of exciting fermentation.

Determination of the Total Nitrogen contained in Manures.—H. Pellet.—The process consists in the addition of a large excess of inert organic matter (starch), and of soda-lime, to the nitrogenous organic matters containing nitrates. A combustion-tube is taken, 70 to 80 c.m. long, the end of which is charged with oxalate of lime and a small quantity of soda-lime: 1 to 2 grms. of the substance under analysis are weighed out, and well mixed in a mortar with 8 to 10 grms. of starch, free from nitrogen, and an equal weight of pulverised soda-lime. The success of the operation depends on the care with which this mixture is made. The tube is then filled up with soda-lime, and the combustion executed in the ordinary manner. The process is not found applicable to the assay of commercial nitrates, as the error would become too great.

Determination of Phosphoric Acid in Natural Phosphates and Manures.—H. Joulie.—A reply to Mène's criticism contained in the *Comptes Rendus* of June 9th. M. Joulie remarks that the process which Mène condemns as inexact is totally distinct from the one which he recommends. He points out that Chancel's process (bismuth), as its inventor admitted, is applicable only to substances containing little alumina and oxide of iron, and free from sulphates and chlorides—a state of affairs very rare in manures, and especially in superphosphates.

Method of Determining the Hæmoglobin in Blood.—M. Quinquand.—The maximum volumes of oxygen absorbable by a given volume of any blood are proportional to the hæmoglobin which these bloods contain. For this purpose it is needful to know the weight of hæmoglobin corresponding to 1 c.c. of oxygen, and to determine exactly the quantity of oxygen which the blood in question retains when saturated: 100 c.c. of human blood contained 260 c.c. of oxygen, ox blood contained 240, and drake's blood 170. The amount of iron contained in 1000 grms. of blood, as determined by Pelouze, is—

Man	..	..	..	..	..	0.53 grm.
Ox	..	..	..	..	..	0.48 "
Drake	..	..	..	..	..	0.34 "

Hence the amount of hæmoglobin in 1000 grms. of blood is in—

Man	..	..	..	..	..	125 grms.
Ox	..	..	..	..	..	120 "
Drake	..	..	..	..	..	82 "

The numbers given by Preyer, as found by a spectroscopic method, are higher, but their relative proportions are the same.

Determination of the Mechanical Coefficients of Food.—A. Sanson.—A mechanico-physiological paper.

Experimental Researches on the Influence which Change of Barometric Pressure Exerts on Vital Phenomena.—P. Bert.—An interesting physiological investigation.

On Aniline Greens.—MM. Lauth and Baubigny.—The authors propose to replace the iodide of methyl, in the manufacture of certain aniline colours, by an ether with a mineral acid, a sulphate, hydrochlorate, nitrate or phosphate, or by the sulpho-conjugated acids of the alcoholic radicals. The best results have been obtained with nitrate of methyl in presence of an alkali or alkaline earth. The energetic action of this ether renders it practicable to operate at low temperatures, either in open or closed vessels.

Photochemical Researches on the Use of Gases, &c.—M. Merget.

Researches on Electricity Produced by Mechanical Action.—M. Joulin.

Polytechnisches Journal von Dr. E. M. Dingler,
No. 2, 1873.

On Pyrometrical Experiments.—A. Weinhold.

Remarks on the Decay of Rocks, and on the Increase of Volume accompanying Crystallisation.—F. Kuhlmann.

On an Alteration of Cast-Iron produced by the Action of a Mineral Water Rich in Sulphur.—E. Prioznik.

Manufacture of Soda by Means of Bicarbonate of Baryta.—G. Lunge.

Processes for the Volumetric Determination of Carbonic Acid.—A. Houzeau.

Determination of the Amount of Acid in Fatty Oils.—M. Burstyn.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin,
June 9, 1873.

Action of Ammonia and its Derivatives upon Ketones in Presence of Dehydrating Bodies.—MM. Engler and Heine.—The authors have investigated the action of ammonia upon acetophenone, and that of aniline upon acetone, both in presence of anhydrous phosphoric acid. In the former case they obtained a base to which they give the name acetophenonin, which shows few noteworthy reactions, and forms well-defined crystalline salts with acids.

Solubility of Saline Mixtures.—F. Rüchhoff.—The author examines those cases where a decomposition is possible. He finds that when ammonia is determined by boiling a solution with caustic alkali, and receiving the ammoniacal fumes in standard sulphuric acid, the alkaline liquid bumps violently on boiling, especially if metallic salts are present. This may be avoided by heating, not by direct fire, but by blowing steam into the liquid.

On Trinitro-Naphthalins.—F. Beilstein and A. Kuhlberg.—The authors distinguish three trinitro-naphthalins: the modification *a* was obtained by d'Agular, on boiling *a*-dinitro-naphthalin (fusing at 211°) with fuming nitric acid. It crystallises from alcohol in saw-shaped leaflets, and fuses at 122°. *β*-trinitro-naphthalin is obtained by boiling *β*-dinitro-naphthalin for a few minutes with 5 parts fuming nitric acid and 5 parts strongest sulphuric acid. It is very readily soluble in alcohol, and melts at 213°. A third modification, *γ*-trinitro-naphthalin, is formed on treating *a*-dinitro-naphthalin with the above-mentioned mixture of sulphuric and nitric acids. It is precipitated with water, and re-crystallised several times from crude nitric acid. It forms splendid pale yellow leaflets. From fuming nitric acid it is deposited in brilliant four-sided tables. It melts at 147°.

Investigations on Isomerism in the Phenol Series.—H. E. Armstrong.

Natural System of the Chemical Elements.—H. Baumhauer.—The author prefers to arrange the atomic weights in the form of a spiral line on a plane surface, hydrogen being placed in the centre. He refers to his pamphlet, "The Relations between Atomic Weights and the Nature of the Chemical Elements," Brunswick, 1870. He points out that, on comparing the atomic weights with the specific gravities of the same bodies, both increase in the same direction in case of a homologous series of bodies. He traces relations of this kind in the following groups:—Sulphur, selenium, and tellurium; chlorine, bromine, and iodine; copper, silver, and mercury; magnesium, zinc, and cadmium; carbon, silicon, and tin; phosphorus, arsenic, antimony, and bismuth; glucinum and aluminium. A remarkable exception is found in the series of alkali metals,—the specific gravity of potassium being not greater, but smaller, than that of sodium.

Metallic Derivatives and Structural Formula of Cyanamid.—E. Mulder.—The author has previously

shown that hydantoin is not formed of the action of alcoholic ammonia upon bromacetyl urea. Neither is hydantoin formed on heating bromacetyl urea with alcohol in a sealed tube. Glucoluril is decomposed by hydrochloric acid into hydantoin and urea. The synthesis of glucoluril, therefore, may lead to that of hydantoin. By the reaction of bromacetyl urea and cyanamid the author obtained not glucoluril, but a sparingly soluble gelatinous body. If an aqueous solution of cyanamid is added to nitrate of silver a fine yellow precipitate is formed. Cyanamid is also precipitated by an ammoniacal solution of nitrate of silver, as the yellow precipitate is sparingly soluble in ammonia. It was found to be a silver substitute of cyanamid, CN_2Ag_2 . If cyanamid is CN_2H_2 , it would be more correctly named carbodimid. Its change into guanidin becomes thus intelligible. An aqueous solution of urea, made alkaline with hydrate of soda, also gives a pale yellow precipitate with nitrate of silver. Silver carbodimid has the following properties:—It is yellow, amorphous, insoluble in water, sparingly soluble in ammonia. It dissolves in dilute nitric acid, and is re-precipitated with ammonia. If potash is added to the nitric acid solution, silver carbodimid is formed again, and can be boiled with an excess of potash without perceptible decomposition.

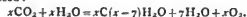
Action of Perchloride of Phosphorus upon Sulphacetic Acid.—R. Siemens.

Action of Sulphuric Acid upon Substituted Anilines.—H. E. Armstrong.—The author has studied the action of sulphuric acid upon ethylanilin and dimethylanilin. He announces as in progress the examination of the sulph-acids formed from the brom- and nitraniline.

The Relations between the Velocity of the Propagation of Sound in Gases and their Molecular Weights.—C. Bender.—The author concludes that these velocities in different gases are inversely as the square root of the molecular weights. Taking the so called "dust-figures" of Kundt, he finds that the velocity of sound in the media in question is inversely proportional to them, and the square root of the densities directly proportional.

On Oxy-cymol and Thio-cymol.—F. Roderburg.—The author seeks to compare the oxy- and thio-derivatives obtained from cymol with those obtained directly from camphor. The experiments show that in cymol-sulphonic acid, and in the oxy- and thio-cymol obtained from it, the inorganic groups occupy the same position as do the oxygen and sulphur in the oxy- and thio cymol prepared directly from camphor.

Respiration and the Inclosed Air of Sugar Beet-Root.—Arnold Heintz.—Sunlight induces chemical transformation in chlorophyll, the vegetable assimilative organ. The substances necessary to build up the body of the plant are produced from carbonic acid and water, oxygen being eliminated. The process may be thus generally expressed:—



If $x=6$ and $7=1$, the result is starch. If $x=6$ and $7=0$ we obtain glycose. The chemical intervention of atmospheric nitrogen in the matters of the living plant-cell is exclusively denominated respiration, and is diametrically opposed to the assimilatory process—the absorption of carbonic acid. Dutrochet rightly compares the respiring plant with insects and other cold-blooded animals, and Sachs likens oxygen to "the spring of a watch," whose elasticity sets all the parts in motion. In the growing plant the elimination of oxygen preponderates, but when the absorption of carbonic acid is interrupted the respiratory process becomes more prominent. As early as 1779 Ingenhousz discovered that roots, flowers, and fruits give out carbonic acid. Respiration, or slow combustion, can be well observed in case of the sugar beet-root, whilst its nutrition is suspended in the winter. The roots stored up for use go on respiring, and their sugar is decomposed,

It was found that a store of 1000 cwts. of roots lost, in two months, 10 cwts. of sugar. The air contained in the roots was found to be—

	Vols.
Carbonic acid	30.52
Oxygen	0.14
Nitrogen	69.34

100.00

Another portion yielded —

Carbonic acid	35.10
Oxygen	0.56
Nitrogen	64.31

99.97

Revue Scientifique de la France et de l'Etranger, No. 50,
June 14, 1873.

Congress of German Naturalists and Physicians.
Session of 1872, at Leipzig. Chemical Section.

Michaelis described certain new compounds of phosphorus. He obtained $P_2S_3Br_4$ by acting upon bromine with trisulphide of phosphorus. By means of this body he prepared PS_2Br and $PSBr_3$, thus completing the group of the sulphobromides of phosphorus. He has also produced a compound of $PSBr_2$ with PBr_3 , and one of $PSBr_2$ with H_2O .

Rathke has formed the compound $CSCl_2$ by acting upon the bisulphide of carbon with chlorine. Another analogous body is produced during the reaction. The author describes the behaviour of these bodies with certain organic principles. Zincke described the compounds benzyl-isoxylol and benzyl-paraxylol.

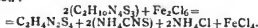
Neubauer showed the presence of quercetin, gallocatechin, malic, oxalic, tannic, and tartaric acids, and of inositol in the leaves of the vine.

Hlasiwetz made known the results of his researches on the protein bodies, undertaken conjointly with Habermann. Rithausen discovered some years ago, among the products of the decomposition of gluten, a new nitrogenous acid, which he named glutinamic, homologous to aspartic acid. The same acid has been obtained from legumin and other matters, so that it may be considered a no less constant result of the decomposition of proteic substances than leucine and tyrosine. Previously, however, glutinamic acid had only been obtained with proteic bodies of vegetable origin. Hlasiwetz and Habermann affirm that it may be obtained from animal proteic matters, and especially from casein.

Tollens made some observations on parabanic acid obtained with uric and nitric acids.

Scheibler described new acid compounds of tungsten.

Hlasiwetz gave an account of some new derivatives of sulpho-carbonic acid, prepared conjointly with Kachler. When bisulphide of carbon and ammonia are brought in contact with a third body, which only acts by its presence, like camphor or phenol, colourless, unstable crystals are produced, $C_2H_4N_4S_3$. Under the influence of feeble oxidising agents these crystals give rise to the following reaction:—



Rhodan ammonium.

$C_2H_4N_2S_4$ forms fine crystals, insoluble in cold water, and resolved by hot water into sulphide of carbon, free sulphur, and sulphocyanide of ammonium. On mixing aniline, sulphide of carbon and ammonia crystals are obtained of the composition $C_{14}H_{18}N_4S_3$, which, if heated with water, yield ammonia, and a body answering to the formula $C_{14}H_{12}N_4S_4$, and crystallising in scales like benzoic acid. It is the sulpho-carbanilide of Hofmann.

Weber treated of anhydrous nitric acid and of a new hydrate of nitric acid.

Lethar Meyer described his arrangement for regulating the pressure of the air in distillation.

Schmitt gave an account of the reaction of chloride of lime on an aqueous solution of the chloride of amido-phenol. In the same manner aniline is transformed into dichlorobenzol.

Grüneberg described experiments made conjointly with Hasenclever on the preparation of chlorine by Deacon's process. Hasenclever and Kemp took part in the discussion which followed.

Tollens described his researches on acrylic acid, undertaken jointly with Caspary. They obtained acrylic acid by means of bromopropionic acid, the preparation by means of allylic alcohol not giving good results. The acid boils at 140° .

Zincke inquired if Tollens had tried oxide of silver or platinum-sponge for oxidising allylic alcohol. Tollens replied in the negative.

Fittig described a new hydrocarbon extracted from coal-tar, having a boiling-point much higher than that of anthracene. It corresponds to the bibasic acid—



Fittig concludes that this new hydrocarbon is phenyl-naphthalin—



The same author gave a communication on allyl-benzol, which he prepared by the action of nascent hydrogen upon cinnamic alcohol. Tollens stated that he had made analogous experiments along with Wagner.

Wedgide described the preparation and properties of carbocyanic ether. It is obtained by distilling two parts of oxamithane and three parts of anhydrous phosphoric acid. It is a clear liquid, insoluble in water, on prolonged contact with which it is, however, decomposed into hydrocyanic and carbonic acids and alcohol. If the ether is treated with ammoniacal alcohol, prismatic crystals are obtained, which the author regards as carbocyanic amide, and by means of which and of chloride of carbonyl he hopes to prepare—



Clemens Winkler made a communication on the analysis of gases, Scheibler adding some remarks.

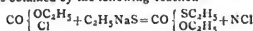
Kolbe described the experiments of Frankh on cyanoforn, and those of Saytzeff on hydride of palladium.

Michaelis described experiments on super-saturation. Weber made some observations on the same subject.

Salomon gave an account of his researches on sulpho-carbonic ether. This ether has, in his opinion, the constitution indicated by the formula—



and is obtained by the following reaction—



This body boils at 155° , whilst its isomer—



boils at 161° .

Landolt, on behalf of Schwartz, communicated a memoir on the equivalents of refraction of carbon, of hydrogen and oxygen.

Salkowski, on behalf of Gintl, communicated researches on the action of ammonia on anisic acid and its nitro-derivatives. The author has obtained a number of very interesting amido-compounds.

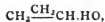
Hübner, on behalf of Zincke, made several communications. He entered into details on the bromo- and nitro-derivatives of toluene, obtained conjointly with Majort. Then he described experiments made along with Scheibler, from which it appears that anhydrous maleic acid in

presence of hydrogen forms succinic acid. He added that, according to Spezia, the nitrate of thallium can be used for the analytical separation of chlorine and iodine.

Zincke, on behalf of Schwartz and Gintl, described the action of zinc upon a mixture of chloride of benzol and of an aromatic hydrocarbon. According to the author, the zinc acts here not chemically but by means of its presence.

Liebermann described certain beautiful blue crystals, to which he has given the name *cerulignon*, and which are found in the preparation of wood-vinegar.

Carstanjen gave a summary of the researches of Schulze on the diffusion of saline solutions. He touched also upon the constitution of allylic alcohol, for which he gave the following "circular" formula:—



which indicates perfectly its relations with glycerin and dichlorhydrin.

Christomenos offered some remarks on a new preparation of diphenyl and diacetyl by electrolytic action.

June 21 and 28, 1873.

These numbers contain no original chemical matter.

Bulletin de la Société Chimique de Paris, tome xix., No. 12, June 20, 1873.

At the meeting of the Society, held May 16, M. Willm exhibited the new bulb apparatus constructed by M. Alvergniat. Three small bulbs, interposed between two large ones, are connected together by S-tubes, so that any gas which it is wished to absorb is compelled to traverse a larger portion of the absorbing liquid than in any other arrangement.

M. Tommasei described certain acid derivatives of naphthylamin, naphthyl-acetamide, and naphthylchloracetamide, obtained by the action of chloride of acetyl and chlorated chloride of acetyl upon naphthylamin.

M. Jungfleisch communicated the continuation of his researches on the action of heat upon rotatory powers.

Right camphoric acid, heated in closed vessels with water to the temperature of 150° to 350°, is transformed into two other acids, optically inactive, bearing to it the same relation which inactive tartaric acid and para-tartaric acid do to right or left tartaric acid. These two modifications are reciprocally convertible when heated along with water.

Heat Liberated by the Mutual Reaction of Alkalies and Water.—M. Berthelot.—The author has studied the action of water upon the hydrates of potassa and soda, upon ammonia, upon lime, baryta, and strontia, both hydrated and anhydrous, in order to obtain a thermic measurement of these reactions.

Function of Atmospheric Nitrogen in Vegetation.—P. P. Dehérain.—This important paper will appear in *extension*.

Observations on a Work by M. Gaudin, entitled, "Architecture of the World of Atoms" (Architecture du Monde des Atomes).—M. West.—The researches of M. Gaudin promise to throw valuable light upon crystallography.

Researches on the Mineral Oils of Buxière-la-Grue and of Cordes.—Jules Jaffré.—An investigation undertaken to ascertain the difference between the mineral oils obtained from bituminous schists and the petroleum of America. The author explains the absence of benzol and of naphthalin in these oils by the fact that the distiller purposely works at temperatures too low to permit of their formation.

A New Method of Assaying Plumbiferous Minerals.—Ant. Mascazzini.—(See vol. xviii., p. 70.)

Determination of Iodine in Presence of Chlorine and Bromine.—H. Hübner.—The method is based upon

the nearly perfect insolubility of thallous iodide in water, and in solutions of nitre, whilst the corresponding chloride and bromide are moderately soluble. The iodine, bromine, and chlorine should be present in the state of alkaline salts, and the solution should be dilute and neutral. A solution of thallous nitrate is added drop by drop until the precipitate formed is perfectly white. The liquid is then mixed with a little water to re-dissolve the white precipitate, and the whole is allowed to stand for 8 to 12 hours. The yellow precipitate of thallous iodide is then collected upon a counterpoised filter, washed with the smallest possible quantity of water, dried, and weighed. The washing-water contains the whole of the chlorine, which is determined as chloride of silver. The determination of iodine in presence of bromine is effected in the same manner. In both cases it is needful to avoid the use of too great an excess of thallous nitrate, and the addition of too large a quantity of water. The different solubility of the iodide and bromide of lead may also be used to determine iodine in presence of bromine by means of nitrate of lead. This method is less trustworthy than the first mentioned, and cannot be employed for the separation of chlorine and iodine.

Falsifications of Albumen.—A. Herburger.—Albumen is often adulterated with gum, dextrin, and starch. To detect these admixtures, 30 grms. of the sample are dissolved in lukewarm water. After some time the mass is stirred. If the liquid contains many white clots, the quality is inferior; that is, a notable quantity of the albumen has been coagulated by the employment of too high a temperature during desiccation. The solution is mixed with acetic acid, and then some alcohol is added to the decanted acid liquid. If gum is present, a precipitate is formed. If starch has been added, it may be recognised in the usual manner by means of iodine. If the albumen contains sugar, it is easily recognised by the use of Fehling's test.

Quantitative Examination of Iron Mordants.—H. Vohl.—If the mordant in question contains chlorine, it is precipitated by means of sulphate of silver, and the chloride of silver obtained is weighed. To determine nitrous and nitric acids, the filtrate is precipitated with baryta. The sulphuric acid and the oxides of iron are precipitated, whilst the filtrate, after prolonged digestion in heat, contains the nitric and nitrous acids in the state of barytic salts. The precipitate is well washed in boiling water, and the excess of baryta is removed by means of a current of carbonic acid gas. The whole filtrate, with the washings, is brought to a definite volume, say 100 c.c. The presence or absence of nitrous acid is ascertained by means of well-known tests. Then the amount of baryta contained in 5 or 10 c.c. of the liquid is determined, either volumetrically or gravimetrically. If no nitrous acid is present, the whole of the baryta present in solution corresponds to the nitric acid, which is thus determined indirectly. If both nitrite and nitrate are present, a known volume is evaporated to dryness, and the residue is taken up in absolute alcohol, which dissolves the nitrite only, leaving the nitrate untouched. The determination of the baryta in each of these salts gives the respective amounts of nitrous and nitric acids. To determine the ferrous oxide in the mordant, it is diluted with water, and digested in the cold with carbonate of lime in a flask filled with carbonic acid. When the liquid has grown clear, it is filtered in a current of carbonic acid and washed in distilled water. The solution containing the ferrous salt is then oxidised with chlorate of potassa and hydrochloric acid, and the ferric oxide thus obtained is precipitated with ammonia. The presence in a mordant of a ferrous salt and of nitrous and nitric acids is in general injurious. (Few, if any, practical men in England will agree with the assertion conveyed in the last sentence. The quality of an iron mordant may be ascertained much more perfectly by dyeing a swatch of calico with it, and with an extract of logwood, than by the operation recommended above.)

Dyeing Aniline Blacks on Cotton Yarn.—MM. de Vinant.—This process requires great care to prevent the blacks from being clouded.—(1). The cotton-yarn, well boiled out, receives seven turns in a bath composed of 200 grms. of sulphate of copper for every kilo. of material, dissolved in water slightly acidulated with hydrochloric acid. It is then well wrung out. (2). It receives five turns in a bath at 50°, containing 50 grms. hydro-sulphate of soda per litre, and is rinsed. (3). It receives seven turns in a bath of 10 litres of water, 180 grms. chlorate of potash, and 170 grms. sal-ammoniac, dissolved in heat, and then mixed with 480 grms. chloride of aniline. (4). It is stretched out very regularly in a hot drying room at 24° for forty-eight hours. (5). Lastly, it receives four turns at 30°, in a bath containing 1 gm. bichromate of potash per litre, and is well rinsed and dried. If the blacks are reddish, they may be passed through a bath containing 1 litre bleaching liquor at 6° to 100 litres of cold water.

Pearl Grey with Aniline Violets.—Aniline violets applied in very feeble tints furnish pearl greys, whose tone varies with that of the violet employed, and is pure in proportion to the excellence of the dye. As the quantity of colour employed is very small, only the highest class of aniline-violets should be employed. Cotton may be dyed without mordant. The bath should contain a little soap, without acid, though a very small quantity of tartaric or acetic acid is added at the end. For pure wool the colour is dissolved in luke-warm water alone, without acid.

Printing Ink for Use in Calico Printing.—The following mixture gives fine results:—

	Parts.
Venice turpentine	9
Soft potash soap	10
Oleoline	4
Lamp-black	6
Bleu de Paris	1
Oxalic acid	0.5
Water	1

The turpentine is first heated along with oleine; then the soap is placed on a levigating slab, and the mixture of turpentine and oleine is very gradually incorporated with it. When this process is complete the lamp-black is worked in, having been first ground and sifted. Finally, with constant grinding, the Paris blue is added, and the oxalic acid and water, which are previously mixed and slightly warmed. The Paris blue and oxalic acid may be replaced with carmine of indigo.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, par Ch. Mène, No. 23, April 11, 1873.

Soaps and Perfumery with an Aluminous Base.—M. Bonnamy.—M. Bonnamy, struck with the inconveniences resulting from the use of toilet soaps with a base of potash or soda, has prepared aluminous soaps. These are, as a matter of course, neutral and free from causticity, and being insoluble in water their detergent action is simply mechanical, not chemical.

Indelible Ink-Powders.—E. Rey.—This paper praises the inks in question, but throws no light upon their composition.

No. 24, April 18.

This number does not contain a single chemical article.

Moniteur Scientifique, du Dr. Quesneville, June, 1873.

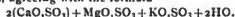
The Function of Septic Agents in the Animal Economy, and the Nature of Septicæmia.—Ferrand Papillon, abstracted from the recently-published results of Davaine.—A very important physiological paper. We note the striking fact that, according to the experiments performed, the septic power of putrescent blood stands in no relation with its offensive odour, the latter continuing to increase while the poisonous properties are diminishing.

The Poles in Magnetisation.—E. Duchemin.—A purely physical paper.

A Patronised Ink.—E. Duchemin.—A controversial paper on a so-called "indestructible ink," which Bous-singault had pronounced indelible, and which the author has succeeded in effacing by means of alcohol and benzol.

Experiments on the Effects of Dynamite.—MM. Roux and Sarrazin.—Dynamite ignited by violent percussion—i.e., by the detonation of a strong fulminating capsule—explodes even in the open air, producing an effect, if confined, equal to that of ten times its weight of gunpowder. If ignited in any other manner, it burns quietly if in the open air, and if confined it explodes. But this explosion, whatever may be the temperature and the pressure, is of a different nature. Instead of a detonation, or explosion of the first order, it is merely an explosion of the second order, equal in effect to that produced by double the weight of gunpowder. The experiments on which this conclusion is founded were made with "No. 2 dynamite" of Vooges, containing 50 per cent of nitro-glycerine, and exploded with a Gevelot detonator, containing 0.25 gm. of fulminate. But even with dynamite at 90 per cent the results were found to be quite similar.

Production of Potash Salts at Stassfurt.—Theodore Becker.—A few details on these mines, which have produced so great a revolution in the manufacture of potash salts, will be useful. Stassfurt is situated about 20 kilos. from Magdeburg, on the Anhalt frontier. The geological formation on which it lies is the variegated sandstone. The presence of a bed of rock-salt below this stratum was suspected in 1838. Borings were executed by order of the Prussian Government, and in 1851 the presence of a deposit of rock-salt, at least 330 metres in thickness, was ascertained. The formal working of the mines began in 1857. Before reaching the salt it was necessary to sink 260 metres through the sandstone, the gypsum, and the marl. The saline deposit does not consist exclusively of common salt, and may be divided into four chief regions. The lowest bed is the largest, and consists entirely of rock-salt traversed by slender veins of karstenite. It is about 240 metres in thickness. We find next the region of polyhalite, still composed of rock-salt, but intersected by veins of 2 to 3 cm. thick, formed of polyhalite, a mineral composed of sulphates of lime, magnesia, and potassa, agreeing with the formula—



This layer is about 64 metres in thickness, and is composed on an average of 91.2 per cent chloride of sodium, 0.66 of karstenite, 6.63 of polyhalite, and 1.51 of hydrated chloride of magnesium. To this stratum succeeds another, of a different composition, and characterised by the presence of a saline mineral named kieserite. It consists of mono-hydrated sulphate of magnesia, in small microscopic needles. The layer contains 65 per cent chloride of sodium, 17 of kieserite, 13 of carnallite (see below), 3 chloride of magnesium, and 2 of karstenite. Its thickness is 56 metres. The upper region is formed of a group of salts chiefly magnesian and potassic, and formerly called *ridgeway salts*, because they were at first without industrial application, and were merely extracted to reach the rock-salt below. These salts are now the foundation of the trade of Stassfurt. The principal salt is *carnallite*, a chloride of potassium and magnesium,—



It has a red colour, due to the presence of oxide of iron in microscopic lamellæ. There are found also, in this deposit, *Sylvine* or *Hewellite*, a chloride of potassium containing often small quantities of sulphate of potassa, and of sulphate and chloride of magnesium; *Tachyhydrite*, a carnallite in which the chloride of potassium is replaced by chloride of calcium; and *Boracite*, a combination of the borate and chloride of magnesium,—



Stassfurt, as we have stated, lies on the Prussian frontier, towards the borders of the duchy of Anhalt. The Prussian workings, therefore, could not be extended to the south-west, where the geological conditions were most favourable. In 1855 the Government of Anhalt commenced operations within its own territory, with perfect success. The saline beds were reached at the depth of 145 metres, and soon a new salt was discovered in great quantity, giving a new impulse to the trade of the district. This is *Kainite*, a compound of sulphate of magnesia and chloride of magnesium. Its discovery enabled the inhabitants to enter upon the manufacture of pure sulphate of potash, which is largely exported to England and the United States. In M. Becker's memoir the reader will find an account of the purification of the crude salts as obtained from the mines. Their applications are numerous. The chloride of potassium is used in the manufacture of saltpetre and carbonate of potassa; the sulphate of potassa is in great demand in the glass and alum-works. Stassfurt exports, also, sulphate of magnesia, chloride of magnesium,—which is extensively used in England for the creditable purpose of adding to the weight of textile goods, and rendering them hygroscopic,—bromine to an extent almost sufficient for the consumption of Europe, and boric acid. Lastly, the impure salts obtained as waste in the various refining processes—consisting principally of salts of soda, magnesia, and potassa—are skilfully combined, and sold as mineral manures, more or less rich in potassa and magnesia. The demand for these manures has greatly increased of late years, especially in England and Germany. In 1869 the Prussian mine alone yielded 109,075,000 kilos. of salts of potassa, and 56,332,000 kilos. of rock-salt, representing a total value of 916,960 francs. (It is interesting to note that whereas the application of potassic salts in agriculture, some fifteen or twenty years ago, was found to produce little or no benefit, they are shown by more recent experiments to be highly valuable. This change is what they would lead us to expect. Liebig has shown that the use of manures which contain only some of the ash-constituents of the crops only enables the soil to be more rapidly exhausted of the other necessary constituents. We have been for years employing manures containing phosphoric acid, lime, and nitrogen, and our soils are beginning to crave a supply of potash.) M. T. Becker's important memoir, on the separation and refining of the various salts and other products above mentioned, will be given at length on a future occasion.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, Tome xxxi., No. 9, June 26, 1873.

Determination of the Alcoholic Strength of Liquors.—If an alcoholic or acetic solution is allowed to flow from a small orifice, the drops are the larger and heavier the more concentrated is the solution. Hence, if we count the number of drops necessary to make up a certain volume, we may, by means of a special table, determine the strength of wine, beer, or vinegar.

New Material for Paper-making.—Messrs. Jourdeuil, Parisot, and Co., of Beire-le-Châtel (Cote d'Or), have patented the stem of the hop as a material for the manufacture of paper.

No. 10, July 3, 1873.

Portable Liquid Gas.—M. Roche, of Paris, has contrived a lamp for burning the light mineral oils without danger or nuisance. He asserts that his lamp consumes, per hour, 50 grms. of light oil, giving a light equal to that obtained from the combustion of 200 cubic metres of coal-gas, the cost ranging according to the price of the oil in different localities, from 1 to 5 centimes.

Zinc-Green.—Elsmar manufactures zinc-greens by mixing 5 parts oxide of zinc, 1 part sulphate of cobalt,

and water enough to form a paste. This mass is thoroughly incorporated and heated to redness, when it yields a fine powder, of a deep green. If the amount of oxide of zinc is increased to 10 parts a grass-green is obtained, and with 20 parts a still lighter. The last proportion serves as a substitute for the dangerous poison known as Schweinfurt-green.

Reimann's Führer Zeitung, No. 25, 1873.

This number contains receipts for dyeing apple-green on wool, cochineal-red on cotton yarn, for which the reader is referred to an advertisement, and Vert Horizon on silk.

Solution of India-rubber for the Manufacture of Elastic Tissues.—The raw india-rubber is soaked in clear water, and boiled for about an hour to remove dirt. It is then taken out of the water, and cut into round slices about 1 centim. in thickness. It is then rolled out into layers about 2 metres long and 0.15 metre broad. The rubber is then dried in a warm chamber. After the drying follows the solution. About 26 kilos. of rolled caoutchouc are placed in a wooden vat lined with zinc, and treated with a mixture of 50 kilos. benzol and 70 kilos. oil of turpentine. Both these liquids must be perfectly free from fatty matters, or the solution of india-rubber will be useless. The caoutchouc, before being brought in contact with the solvents, is torn up into small fragments. The mass is stirred occasionally till it forms a thick, homogeneous liquid. To test the benzol and turpentine, small portions of each are evaporated to dryness in the water-bath. If any trace of fat remains the sample is at once rejected.

The Editor gives also receipts for a Russian green on wool, for yellowish brown, red-brown, and alkali-blue on cotton; and for printing rainbow styles in rose, blue, and orange.

Products of Resin.—Schroeder, during an investigation of the oxidation-products of rosin (colophonium), discovered an amorphous resinous acid, isophthalic and trimellitic acid—a derivative of the acid occurring in mellite.

New Washing Agent.—A contemporary Journal, devoted to the art of dyeing, informs us that *paraffin* is now used instead of benzol or turpentine for cleansing textile fabrics.

Utilisation of Old Dye-Liquors.—As a means of extracting from such liquors everything of value, it is proposed that the bath in which scarlet has been dyed should be gradually exhausted by dyeing with it successively lighter and lighter shades. A better proposal is, where practicable, to keep one and the same bath for the same colour. (Many experienced scarlet-dyers maintain that an old flot gives the best results.)

Dressing for Silks.—A solution of gum tragacanth is recommended. Silks got up in this manner do not show rain-spots.

NOTES AND QUERIES.

Lemon-Yellow.—I shall take it as a great favour if you or any of your correspondents will kindly inform me how to make a bright lemon-yellow from chromate of potash and nitrate of lead—a yellow that will keep its colour on exposure to the air and after being well washed; I have tried many experiments, but they all change to a deeper colour. If you can give me any hints about the same, I shall feel greatly obliged.—L. C.

TO CORRESPONDENTS.

Miss B.—Your enquiries should be addressed to a medical paper. *Volta*—Prussian blue, dark ultramarine, or finely-ground indigo may be used; but there are no pigments soluble in insed oil. *J. E. Armstrong, H. W. and others.*—Messrs. Trübner and Co., of Ludgate Hill, would procure it for you.

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ON THE PHRASEOLOGY EMPLOYED IN TEACHING FUNDAMENTAL FACTS IN CHEMISTRY.

By C. R. A. WRIGHT, D.Sc. (Lond.).

Lecturer on Chemistry in St. Mary's Hospital Medical School.

(1). THE phraseology ordinarily in use in the description of fundamental chemical phenomena is open to the objection that either it is diffuse and wanting in terseness and precision, or else words are employed which go beyond the requirements of the moment, inasmuch as they connote not merely the facts themselves but also hypotheses, the full discussion of which is impossible at the commencement of a course of instruction; in consequence, a tendency to one-sidedness in looking at questions concerning theory and speculation is often unintentionally developed. The student, being taught to take certain matters of this kind for granted during the early part of his course of study, is frequently unable to divest himself wholly of preconceived notions on the subject at a later period in his course of study, when he comes to examine the bearings and scope of these hypotheses. To render the fallacy of *petitio principii* less imminent, the mode of teaching certain fundamental doctrines briefly described below is suggested, the method having been tested by some years' trial and found to meet the requirements of the case, viz., enabling the facts themselves to be stated in terse language, without involving in any way any assumptions or hypotheses whatever beyond certain universally admitted conventions.

(2). Quantitative analysis shows (Dalton) that any pair of so-called elements capable of being obtained from a given homogeneous compound* (and hence stated in ordinary language to exist in, or be components of, that compound) are present in that compound in proportions by weight, related by a simple numerical law to those in which the same pair of elements exist in any other homogeneous compound; this law of multiple proportions being that if the relative quantities by weight in which any two elements co-exist in a given compound be represented by a and b , the relative quantities in which they co-exist in any other compound are indicated by a' and $\frac{m}{n}b$, where m and n are integers rarely of high value.

Like all experimental generalisations, this statement only expresses the result of any given experiment within a certain degree of approximation; but it is uniformly found that the more care be taken in the quantitative determinations of the substances present, the more accurate the processes employed, and the greater the purity of the body operated on, the more nearly is the result of each experiment expressed by the generalisation.

(3). It hence follows that the composition by weight of all homogeneous compounds is indicated by the general formula, $x_1c_1 + x_2c_2 + x_3c_3 + \dots + x_nc_n$, where—

$$c_1, c_2, c_3, \dots, c_n$$

are certain numbers applied respectively to each of the n known elements, and x_1, x_2, \dots, x_n coefficients, the values of which are 0 in the cases of such elements as are not present in any given compound under consideration, and are simple integers in the cases of such elements as are present in that compound. The value of the c 's thus

* Solutions and other apparent exceptions to this rule are generally viewed as not being homogeneous compounds, but as being simply indeterminate mixtures of two or more dissimilar substances.

obtained from quantitative analysis, and so chosen that the values of the x 's in the general formula shall be as low as possible in most cases, constitute what are spoken of as the *combining numbers* of the elements. Thus, 1, 6, and 8 being the combining numbers of hydrogen, carbon, and oxygen respectively, many compounds of these elements have compositions expressed by the formula $m \times 1$ (of hydrogen) $+ n \times 6$ (of carbon) $+ p \times 8$ (of oxygen), where m, n , and p have very simple values. Thus—

Water	$m=1$	$n=0$	$p=1$
Carbonic acid ..	$m=0$	$n=1$	$p=2$
Carbonic oxide ..	$m=0$	$n=1$	$p=1$
Marsh-gas	$m=2$	$n=1$	$p=0$
Acetic acid	$m=1$	$n=1$	$p=1$

&c., &c.

From these considerations, then, are derived what are spoken of as the "Old series of combining numbers" (Dalton, Berzelius, &c.).

(4). Manifestly any one of this series of numbers might be multiplied or divided by a simple integer without invalidating the applicability of the general formula. Thus, if $2c_n$ were taken as the combining number instead of c_n , a compound indicated by the formula—

$$x_1c_1 + x_2c_2 + \dots + x_nc_n$$

on the old scale would be indicated by—

$$2x_1c_1 + 2x_2c_2 + \dots + x_n(2c_n)$$

or if $\frac{c_n}{2}$ were taken instead of c_n , the same compound

would be indicated by— $x_1c_1 + x_2c_2 + \dots + 2x_n\left(\frac{c_n}{2}\right)$

For convenience, a "new series of combining numbers" is constructed (Gerhardt, Cannizzaro, &c.), where the combining numbers are in some cases identical with the old ones, in others are multiples of them, the precise value of each number being fixed by reference, not merely to gravimetric composition, but also to volumetric composition and the specific gravity of the substances concerned in the vaporous state (Criterion I.). When this criterion is inapplicable, a convention based upon specific heat is taken (Criterion II.); and where both of these criteria are inapplicable, chemical analogy is taken as Criterion III.

(5). *Criterion I.*—Experiment shows (Gay-Lussac) that a given bulk of any compound vapour contains a volume of any volatile component element (examined under the same circumstances of temperature and pressure) which is an integral multiple of a simple fraction of the bulk of the compound vapour; i.e., one volume of compound vapour contains $\frac{m}{n}$ volumes of each vaporous constituent element, m and n being integers rarely of high value, and varying in value with each constituent and with the nature of the compound.

(6). As a subsidiary unit of volume (the absolute unit being 1 cubic metre) is chosen the (variable) bulk occupied by 1 gm. of hydrogen under the conditions that obtain during any given experiment under consideration. This unit, which may be conveniently designated as a *metropneum* (μτρον and πνευμα) has, at a pressure p and a temperature t , approximately the value—

$$0.0112 \times \frac{273+t}{273} \times \frac{760}{p}$$

absolute units of volume. Hence one metropneum of compound vapour contains $\frac{n}{m}$ metropneums of any given

gaseous elementary constituent, m and n being integers.

(7). The vapour density of any given constituent being s in reference to hydrogen, $\frac{n}{m}$ metropneums of that con-

stituent must weigh $\frac{n}{m} \times s$ grms.; i.e., one metropneum of

compound vapour contains $\frac{ns}{m}$ grms. of any given vapor-

ous elementary constituent. Taking into consideration all the volatile compounds of this element (i.e., all the different values which the expression $\frac{ns}{m}$ can have, m and s being constant), there must be a greatest common measure of all these values; the numerical value of which G. C. M. must be $\frac{s}{m}$, when n has in each case the minimum integral value possible.

Thus the following values of the G. C. M.'s are obtained:—

Hydrogen ..	0.5	Mercury ..	100.0
Nitrogen ..	7.0	Arsenic ..	37.5
Oxygen ..	8.0	Phosphorus ..	15.5
Sulphur ..	16.0	Bromine ..	40.0
Chlorine ..	17.75	&c., &c.	

The values of m in the expression $\frac{s}{m}$ (when this expression is the G. C. M.) being found to be—

1. In the case of mercury (probably zinc, cadmium, &c.).
2. In the case of hydrogen, oxygen, chlorine, bromine, iodine, probably potassium (Dewar and Dittmar), nitrogen, sulphur (at high temperatures), &c., &c.
4. In the cases of arsenic and phosphorus.
6. In the case of sulphur (at comparatively low temperatures).

(8). Hydrogen being conveniently made a standard of reference, its combining number is taken as unity; hence, all the other numbers require to be doubled: whence the following equation— $C_n = 2g_n$, when C_n is the combining number (new series) applied to any given element, and g_n the G. C. M. for that element obtained as above from the vapour density of the element, s , and the experimental determination of the minimum value of m .

(9). Many elements not themselves volatile at measurable temperature yield volatile compounds with other elements; e.g., carbon, boron, silicon, iron, &c. When several volatile compounds of a given element are compared, it is uniformly found that the numerical values of the weights of that element contained in a metropneum of each compound vapour respectively have a G. C. M., just as the numerical values of the weights of any volatile elements contained in a metropneum of all its compounds respectively have a G. C. M., viz., $\frac{s}{m}$.

Twice the value of this G. C. M. is similarly taken as the combining numbers of the element in question (new series).

(10). The experimental errors involved in vapour density determinations are frequently of such magnitude that the results of any one given experiment only approximate to those which would be in exact conformity with the generalisations of the existence of a G. C. M. of the weights or volumes of a given element contained in a metropneum of the vapours of each of its compounds; still, the more care is taken in avoiding sources of error, the closer is the approximation.

Where a combining number is fixed by the determination of a G. C. M., it is evident that the existence of only one or two volatile compounds renders the determination impossible or unsatisfactory; i.e., the combining number thus deduced is not always identical with that fixed by Criterion II. or III. (*infra*). Thus, from the vapour density of ferric chloride, 112 would be taken as the combining number of iron; but both the specific heat of metallic iron and analogy with aluminium (the combining number of which, deduced from the chloride, is double of that deduced from the methide and ethide, Buckton and Odling), indicate 56 as the combining number.

Compounds that decompose on heating, or "dissociate," are of course excluded in the determination of a G. C. M., there being no longer one homogeneous body to deal with in such cases.

(11). Criterion II.—In the case of all elements that are solid at measurable temperatures, and the melting-points

of which do not greatly exceed the melting-point of platinum (i.e., in the case of all elements that give volatile compounds, save those gaseous at the common temperature, carbon, silicon, and boron), it is found that the apparent specific heat of the solid element between t^0 and $t^0 + 1$ (where t^0 lies between -50 and $+100$) closely approximates to $\frac{6.5}{c}$, where c is the combining number

(new scale); or $c = \frac{6.5}{h}$, where h is the apparent specific heat.

In the case of elements where Criterion I. is not applicable, it is found that a very simple multiple of the combining number (old scale) ($\frac{1}{3}$) also closely approximates to $\frac{6.5}{h}$; this multiple of the old combining number is then taken as the combining number (new scale).

Thus the combining number of iron (old scale), deduced from gravimetric analysis only, is found to be 28; the apparent specific heat, however, closely approximates to $\frac{6.5}{2 \times 28}$; wherefore, 2×28 , or 56, is taken as the combining number (new scale). Similarly, 113.4 is taken as the combining number of indium (Bunsen), instead of $37.8 = \frac{113.4}{3}$, as deduced from gravimetric analysis only.

(12). Criterion III.—The particular cases of the general expression, $x_1c_1 + x_2c_2 + x_3c_3 + \dots + x_nc_n$, produced by varying the values of the x 's, may be briefly denoted by applying to each element actually present in a given compound a symbol indicating its name and combining number, and repeating each symbol as many times as is denoted by the value of the x attached to that symbol in the particular case examined. Thus, a collection of symbols, termed a *formula*, is obtained; when the x 's have the minimum possible values, the formula is termed an *empirical formula*. Thus, water is indicated by the empirical formula HHO; butyric acid by CCHHHHO. This notation is conveniently abbreviated by writing a suffix, x , instead of repeating the symbol x times; thus—Water, H_2O ; butyric acid, $C_4H_8O_2$.

(13). Formulae, however, may be made to indicate not only the ratio by weight and volume in which the components are present, but also their vapour densities. From the circumstance (§ 8) that double the G. C. M. for any given element is taken as the combining number of that element, it follows that the empirical formula of a compound must indicate either the weight of two metropneums of that compound, or a sub-multiple thereof; and hence, by multiplying the empirical formula by some suitable integer, a formula (termed the *rational formula* of the compound) is obtained, which denotes not merely the gravimetric and volumetric composition of the compound, but also the absolute weight in grammes of two metropneums of its vapour. Thus, the rational formula of water is identical with the empirical formula H_2O ; the rational formula of butyric acid is double its empirical formula, being $C_4H_8O_2$.

(14). Elements which do not yield volatile compounds, and the apparent specific heats of which are unknown, have combining numbers which are fixed by this convention; such multiples of the numbers deduced from gravimetric analysis (§ 3) are taken as will enable compounds of these elements to be indicated by formulae which resemble in suffix values the rational formulae of compounds of other elements to which the first-named compounds are chemically analogous.

Thus (apart from evidence derived from Criteria I. and II.), the rational formula of aluminic chloride is Al_2Cl_6 ; ferric chloride is chemically analogous to aluminic chloride, and can be indicated by a similar formula, Fe_2Cl_6 , if the value denoted by Fe (combining number, new scale) be made = 56.

(15). The symbols involved in chemical formulae, though

unlike algebraic ones in this respect, that juxtaposition does not mean multiplication (the sign + being understood between each pair of adjacent symbols), are yet like them in one property, viz., that of commutation; by adopting fixed conventions as to the mode in which the symbols in a rational formula are arranged among themselves, many facts in the chemical history of a compound may be indicated. Thus, the rational formula of acetic acid being $C_2H_3O_2$, or $CCHHCOO$, a great many facts and chemical changes in which acetic acid is concerned may be at least partially indicated and called to mind by arranging these eight symbols thus— $CHHHCOOH$, or $CH_3.CO.OH$. Formulae whose constituent symbols have been thus arranged, so as to connote points in the chemical history of the compound indicated, are referred to as *dissected formulae* (structural formulae).

(16). From the above definition of a rational formula, it is evident that every such formula indicates the same bulk, viz., two metropneums; the concrete weight in grammes of this bulk of compound is conveniently referred to as a *metrogramme* (or *metrogram*). Thus, the metrogram of water is 18; i.e., 2 metropneums of steam weigh 18 grammes.

(17). In the case of elements, rational formulæ are applied, based on the same principles as those in use for compounds. Since $2\frac{x}{m}$ is by definition the combining number (§ 8), and as $2x$ indicates the weight of 2 metropneums, m must indicate the number of times the symbol is repeated in the rational formula of the element; thus—

Element.	Rational Formula.
Mercury	Hg
Hydrogen	HH or H_2
Chlorine	ClCl or Cl_2
Oxygen	OO or O_2
Ozone	OOO or O_3
Phosphorus	PPPP or P_4
Sulphur (at low temperatures) ..	SSSSS or S_8
.. (at high temperatures) ..	SS or S_2

It may be noticed, *en passant*, that allotropic modifications are often indicated by different rational formulæ; e.g., oxygen and ozone, or the two allotropic sulphur vapours.

(18). The rational formulæ of non-volatile elements and compounds are necessarily indeterminate; in this case the convention is adopted that the empirical formulæ are regarded as the rational ones (unless reasons based on analogy or chemical properties lead to higher formulæ). The empirical formula of an element necessarily consists of a single symbol; thus silver is considered to be indicated by the rational formula Ag; analogy with hydrogen and potassium, however, would lead to the rational formula Ag_2 .

Chloride of sodium similarly is assumed to have the rational formula NaCl, although it is not at all improbable that a higher formula may hereafter turn out to be the rational formula.

In most cases analogy and other circumstances are in favour of the identity of the empirical and rational formulæ, but not always. Thus (apart from vapour density) the empirical formula of ferric chloride is $FeCl_3$; analogy with aluminic chloride would double this formula, and the determination of the actual vapour density of ferric chloride also gives the rational formula Fe_2Cl_6 .

(19). The term a *proportion* may be conveniently used to indicate not a fixed concrete amount like the metrogram, but a *relative weight*—which is taken in the ratio of the metrogram in the case of compounds, in the ratio of the combining number in the case of elements. Thus—

1 proportion of hydrogen =	1 part by weight.
.. .. oxygen =	16 parts
.. .. water =	18 ..

(20). By the use of the terms *combining number* (new scale), *metropneum*, *metrogram*, and *proportion* as above

defined, the fundamental facts connected with the gravimetric and volumetric composition of substances, and their vapour densities, can be expressed in terse language which involves no hypothetical assumption whatever. Thus the essential facts connected with water are—

1. Oxygen, hydrogen, and no other elements are present in water.
2. These elements are present in the respective weights 8 and 1.
3. These elements are present in the respective volumes 1 and 2.
4. The vapour densities of steam and oxygen are respectively 9 and 16 in reference to hydrogen.

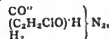
Then the phrase "one proportion of water contains one proportion of oxygen and two of hydrogen," or "one metrogram of water contains half a metrogram of oxygen and one metrogram of hydrogen," indicates all these facts, it being remembered that the rational formulæ of oxygen and hydrogen are O_2 and H_2 respectively.

All the advantages of succinctness and terseness possessed by such phrases as the following—"The molecule of water contains two atoms of hydrogen and one of oxygen, the molecule of oxygen containing two atoms of oxygen, and that of hydrogen two atoms of hydrogen"—are thus gained without the use of language necessarily involving hypotheses or assumptions; and hence, by employing the terms above defined, the mind of the student may be left wholly free to appreciate the just value of such hypotheses when his knowledge of facts is sufficiently extensive to enable him to understand their bearings.

ON A COMBINATION OF UREA WITH CHLORACETYL.*

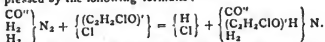
By M. D. TOMMASI.

THIS compound, which results from the substitution of an atom of monochloroacetyl, C_2H_3ClO , for an atom of hydrogen in urea, and which I shall designate by the term chloracetyl-urea—



is produced by the direct combination of urea with chlorated chloracetyl.

In order to prepare this compound, there is introduced into a long-necked flask, well dried, a molecule of urea previously desiccated at 100° , and a molecule of pure chloride of chloracetyl. The mixture of the two bodies is effected without disengagement of heat; but soon there is established a brisk reaction, the mass becomes liquid, strongly heated, and commences ebullition; quantities of hydrochloric acid are disengaged, and at the same time a white solid mass attaches itself to the sides of the flask. This reaction should be left to itself, and when it is terminated the flask should be heated for some hours in a water-bath until the reaction is completed, which is expressed by the following formulæ:—

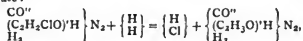


The white product which covers the sides of the flask is washed several times with cold distilled water, pressed between folds of paper, and dissolved in boiling alcohol; the alcoholic solution is to be filtered, and allowed to remain during twenty-four hours. At the end of this time the capsule will be covered with beautiful light yellow-coloured crystals, which may be purified by several crystallisations in alcohol with some animal black.

Chloracetyl-urea crystallises in fine colourless needles

* Communicated by the Author.

insoluble in cold water, slightly soluble in boiling water. Alcohol at 40° density dissolves it feebly in the cold, and in rather greater quantity with heat. Heated on an oil-bath in a test-tube, it commences to decompose at a temperature of 160° at the same time a small portion of the unaltered product is sublimed and deposited on the cold sides of the tube in fine white and silken needles. Heated on a plate of platinum, chloracetyl-urea melts and disengages white vapours. Fuming nitric acid attacks it at the ordinary temperature, with disengagement of gaseous products, amongst which I have ascertained the presence of carbonic acid. Concentrated nitric acid very slightly dissolves it in the cold, in greater quantity with heat without decomposition. The behaviour is the same with sulphuric, hydrochloric, and acetic acids. Chloracetyl-urea is not precipitated by mercurous nitrate, nor by nitrate of silver. When we cause nascent hydrogen to react on chloracetyl-urea, in the place of obtaining acetyl-urea and hydrochloric acid, as the following equation would indicate:—



we obtain a crystallisable compound very soluble in cold water. Not having at my disposal sufficient quantity of this new product, it has been impossible for me to analyse it.

The analysis of chloracetyl-urea has given the following results:—

	Calculated. (C ₂ H ₃ ClO''N ₂)	Observed.
Carbon ..	26.37	27.01 26.52
Hydrogen ..	3.66	3.87 3.69
Chlorine ..	26.00	25.99 25.46
Nitrogen ..	20.51	20.11 20.63
Oxygen ..	23.46	" "

When a small quantity of chloracetyl-urea (about half a milligramme) is placed on the end of the tongue, we experience no particular sensation: but soon, at the end of two or three minutes, there occurs a burning taste in the larynx, accompanied with sharp pain and a sensible difficulty of respiration. These symptoms disappear ordinarily in an hour.

We may conclude, from experiments made on animals, that chloracetyl-urea does not belong to the class of violent poisons.

These researches have been made at Sorbonne, in the chemical laboratory of M. Schützenberger.

INDIUM IN AMERICAN BLENDES.

By H. B. CORNWALL, E.M.

In a specimen of zinc blende from W. Ossipee, New Hampshire, handed me by Mr. Lewis, of the firm of Webster and Lewis, metallurgists, I have detected by the spectroscope a notable amount of indium. The blende is resinous in appearance, with rather large cleavage surfaces, and is extensively mined for the purpose of obtaining lead and silver, as it carries a considerable proportion of somewhat argentiferous galena. It was examined by the method given by Richter in Plattner's "Manual of Blowpipe Analysis," viz. solution in nitro-hydrochloric acid, filtration, and precipitation of the oxides of iron and indium with a sufficient excess of ammonia to re-dissolve the oxide of zinc. The precipitate, collected on a filter and thoroughly dried, was then moistened with hydrochloric acid, and tested with the spectroscope, giving one distinct indium line.

A second specimen, from the cabinet of the School of Mines, labelled Eaton, N.H., also gave a fainter indium reaction, but, as it is very similar in appearance to the above blende, I think they are probably from the same vicinity. To obtain the indium spectrum from this second

specimen, it was necessary to repeat the operation of moistening the oxides and bringing them into the flame two or three times, as thus the chloride of copper spectrum, due to imperfect washing of the precipitate, grew gradually less intense, and the indium line could be discerned flashing out just as the oxides were brought into the flame, and before the chloride of copper spectrum appeared.

On this second specimen I also tried precipitating the indium from the original solution with zinc, after evaporation with sulphuric acid and separation of the sulphate of lead, but the indium line could not be seen much better than by the other method, which is more rapid.

The following blendes were examined without showing indium:—From Warren, N.H.; Wurtsboro', Ellenville, and Lockport, N.Y.; Phoenixville, Friedensville, and Wheatley Mine, Pa.; Ducktown, Tenn. (the variety rahtite); Shulsburg, Wis.; and Galena, Ill.

PS. Since writing the above, I have examined blendes from Silver Hill, N.C.; Prince's Bay, Lake Superior (with native silver and calcite); Alpine Co., Col.; and Roxbury, Conn. The Roxbury blende contains so much indium that it can be detected in the raw powdered blende, without using acids.—*American Chemist*.

ON THE ENERGIES OF THE IMPONDERABLES, WITH ESPECIAL REFERENCE TO THE MEASUREMENT AND UTILISATION OF THEM.*

By the Rev. ARTHUR RIGG, M.A.

(Continued from p. 17).

We are indebted to "energy" for all we have, and all that men have won. For example, this building and all that it contains is an example of one of the energies of gravity. The lightning, with its thunder, is an example of the energy of electricity. Power of hearing and of speaking are examples of the energy of vitality. The bread eaten and the wine drunk are assimilated and become ours by the energy of affinity. It is owing to the energy of light that vision can be had; and to the energy of heat that railways and locomotion can be utilised.

The word "energy" itself, which has in these days, Phoenix-like, risen from its ashes, and which plays so important a part in the title to this course of Cantor lectures, may properly claim some notice.

The word has been adopted, rejected, and revived. It seems to have been first used by Lucretius, a Roman philosopher, who was born B.C. 95 and died B.C. 55. The word had been forgotten or laid in oblivion until Dr. Young, in his lectures at the Royal Institution in 1807,† explained what he meant by energy, and illustrated his meaning by the impact of an ivory ball or balls upon a line of suspended balls.

Here are several ivory balls suspended so as to touch each other. If the end one be raised a little, and then allowed to fall, the ball at the other end will be driven away. The motion in the last ball resulted from energy expended in the raising of the first ball, and this first ball was raised by the energy of vitality. When, however, vitality no longer puts forth energy, then the energy of gravity operates, and causes the ball to fall. Such a simple experiment revived the word "energy," which has thus been re-introduced, and bids fair to hold an important place in science annals for some years.

* The Cantor Lectures, delivered before the Society of Arts.
† In Lecture 8, Young wrote:—"The term 'energy' may be applied with great propriety to the product of the mass (or weight) of a body into the square of the motion expressing its velocity." This is not "energy" according to modern usage, but, for reasons which need not at present concern us, it is doubtful that to which in these days the term "energy" is applied.

Energy is from two Greek words, *en*, within, and *ergon*, work; used in its true sense, it means the work "that is within." Whenever, then, we find that a power to do work exists, we may say, "there is energy." It needs not that the work be done, it is immaterial how long it has lain dormant, or whether it be in man's estimation great or small; we only need the assurance that there is the capacity to do. A loaded gun need not be discharged to assure us that in that which is in the gun is energy, and yet to ascertain or measure the energy the discharge must take place. When that has happened, we may say, within the gun is no energy. The gun itself is merely a contrivance by which certain combinations may be induced to exercise their energies; it has nothing to do with the communication or even introduction of the energy utilised. When the energy is within the barrel, and inoperative, we handle and play with the gun, disregarding the thought of energy, but when the energy of quiescence is to become energy in action, it behoves us to play with the gun no longer.

But how can the gun be again a means or an agent through which some one or other energy may re-manifest itself. Clearly by another group of quiescent energies being introduced. This illustration of an expended and a re-introduced energy may suffice to give a character to an element in respect of all the energies, viz. their expenditure and re-introduction or re-creation. Either through the innate operation of natural causes or through the agency of vital energy, there must be a restoration. These restorations are effected in ways to which the name of legion may be applied. For example, a weight requires energy to raise it, a spring requires energy to bend it, air in a gun requires energy to compress it, before any of these can be said to have energy in possession. The water in a mill-pond has been raised by the energy of the sun. The chemical affinities in a galvanic cell are innate. A labourer and a horse require food that they may work. So with many similar illustrations. In all these is a dormant or quiescent energy. Once let it loose and the Arabian Night's story of Sinbad and the Giant, or that boast of *Owen Glendower*, that he could

"Call spirits from the vasty deep,"

would not be met with *Hotspur's* taunt—

"Why, so can I, or so can any man;
But will they come when you do call for them?"

These energies always come when rightly summoned.

Observe, energy presents itself in two forms—energy in quiescence, and energy in action. To these forms technical names have been given. Energy in quiescence is called potential energy; and energy in action is called kinetic energy. In this weight, suspended as pendulum, these two energies may be illustrated. If the weight be struck from its lowest position, then the kinetic energy of vitality as manifested through muscular action, sets it off. But if the weight be elevated and simply let fall, then the potential energy stored up in the act of lifting becomes kinetic energy, through the influence of what we call gravity.

To sum up. Belonging or attached to all that is material are certain powers or influences which cannot be separated and so weighed; hence these powers or influences are said to be "imponderable." Since these powers or influences affect the motions of bodies they are called forces, for force is that unknown influence which causes, retards, stops, or accelerates motion.

Again, when by such arrangements as nature calls into play, or men can contrive, these forces manifest themselves in action, they are said to be energetic.

Now, since we can plan to some extent how and when each force should manifest its energy, and obtain or retain the results, these results are called work. This may be measured or weighed, and it is through such work alone that a value can by men be placed upon the forces of the imponderables, which, by their energy, have done work.

The measurement, therefore, of the energies of the imponderables resolves itself into a measurement of the work they do. It is, therefore, very essential that the measurement of work should be by means easily reproducible, scientifically accurate, of universal application, beyond all question and all cavil, admitting of no elements which, under any circumstance, could vitiate or falsify a conclusion.

Three elements only are needed to fulfil these conditions, viz., the mass of the body moved, the space through which it moved, and the time during which by the operation of some force it was being moved. These three elements being known, all others or varieties can be derived from them; hence all others are called *derived* measurements. Reasoning thus, a pound weight from which mass may be deduced, a two-foot rule by which space may be measured, and a clock by which time may be noted, are all that we require in England in order to determine measurements of work. But very clearly these three sources of fundamental units must be of an irrefragable character. Speaking generally, who dares venture to say that the pound weight he has, or the clock he has, or the two-foot rule he has, is more to be relied upon than the corresponding instrument in the possession of his neighbour? 'Tis amusing to listen to the pleadings of the owners of watches and two-foot rules, and scales and weights, as to the wonderful accuracy of those they possess.

Where lies the appeal? Who shall decide whether the second ticked by the watch which cost thirty shillings or that ticked by the chronometer which cost one hundred pounds is to be the true second? Who shall decide the inch and the pound when the owners disagree? The answer to these questions, doubtless, resides in your minds forms of difficulties not easily solved.

It may suffice, for this evening, to glance at one or two of these difficulties, in order that we may not think it a trifling with important interests in what, perhaps, seems a kind of childish quibbling, to suggest as a difficulty in such common affairs as a pound-weight, a second, and an inch. Let us first see that from these can be had all we use as measures.

When we say of anything it measures ten, twenty, thirty, or forty, we may add the words inches, feet, yards, or miles. These words must be in some way related. The measurement thus expressed consists of two parts, a numerical and a denominational one. The numerical is absolute and independent of the denominational one. This latter is, for a special case, the unit of measurement; hence there may be a great variety of units, all, however, by their inter-relations, capable of being resolved into one. This one, this original, this is the difficult one to decide, and to it a portion of the next lecture must be given.

So far, then, for the unit of space. Now as to time. Let anyone attempt to measure time by the repetition of a unit derived from any ordinary source, and he will soon find himself in a labyrinth of doubts. All our measures of time are derived from astronomy. Of the unit of this our future grain there is the compound measure which some may say is put beyond the reach of such disparaging remarks, viz., that invaluable measure in all commercial transactions, the pound weight. Time is our own; we waste it as we please; we do not pay for it. Space is our own; we can walk where and as we please; but, as to our food, that is ours by purchase, and we buy it by the pound weight.

Well, "truth," the proverb says, "is mighty and must prevail." The pound weight is quite worthless as a scientifically accurate and universal measure. There is really no such thing as weight for a universal measure, and yet nobody ever bought a pound of sugar without thinking they were getting at one time the same quantity as at another. That is not the case. Weight, speaking accurately, is a most variable measure, and is therefore one on which no reliance is to be placed in scientific

investigation. What we do measure, scientifically speaking, when we speak of weight, is mass, and an endeavour shall be made to show you the difference between mass and weight.

First, weight is not at all to be relied upon. Here is a jar of water balanced on a scale-beam, but so as to hardly equal the weights on the other side. If I put my finger in the jar, the jar overbalances the weights. But why should the scale-pan sink when one simply touches the water with the hand? It is not pressed down. The hand is merely put into another atmosphere, water, instead of air. Lest anyone should think that the jar is pressed down, let a weight hanging by a string, which sustains the weight, be suspended in the water, still the scale pan in which the jar of water is descends. Therefore the weight appears to be altered—there seems something or other about it which is not altogether correct. The matter presents itself again in this form. Here is a scale-beam with a block of wood at one end, and an exactly balanced weight at the other. Now, as the weights pass from one atmosphere to another they change in their relationship; and whilst the mass or quantity of matter contained in this block of wood and in this counterpoising weight remains the same, yet the relation of the weights does not remain the same. Some may say that if the matter undergoes no change, then the weight undergoes a great change, but the matter undergoes no change. At present, both are in an atmosphere of air, and you see that the beam is in exact equilibrium; but now let each be immersed in an atmosphere of water, and you see at once how the relationship to each other is changed; they no longer balance. The mass of wood is the same as before, and, therefore, as far as moving from one atmosphere to another is concerned, masses must be considered, and not weights; therefore, where the atmosphere changes, there we must give up the idea of weight. There is another cause why weight will not act as a standard unit. Weight results from the action of gravity; it is not a property of matter at all. If we change the force of gravity which tends to pull a mass down, we then change the amount of pressure that the mass exerts on a spring. If we take a mass of matter at one of the poles, it is nearer to the centre of the earth than if it were at the equator, and in consequence it will be pulled down with greater force, so that what would weigh (say) 1½ lbs. by a spring balance at the pole, would weigh (say) 1½ lbs. at the equator. Therefore, if we ordered a quantity of goods to be sent from some place near the poles towards the equator, and they were weighed by a spring balance, they would not weigh so much on reaching their destination as they did when they were shipped; and yet the quantity of matter would be exactly the same.

Observe, it is a spring balance, and not a scale beam, that is used. A spring balance measures force only, viz., in this case the depressing or pulling down force of gravity at the place where it is used. With a spring balance a gravitation experiment is made. If a scale beam be used, then as the change of gravity affects the weight in each scale pan equally, the relations between them will not be affected, and the scale beam will be in equilibrium when the contents of the scales are influenced by the varying force of gravity.

You saw, a short time ago, that weight varies by taking the mass into an atmosphere denser than that in which we live, and now you shall see the same result by changing the atmosphere for one more rare. Here is a glass beaker, suspended bottom upwards by a hook, so as to exactly balance a weight at the other end of the cord; the system is now in equilibrium. I will change the atmosphere within the beaker by admitting some ordinary coal gas into it, and you see the weight changes at once; the beaker appears to be lighter. These illustrations show that dealing with weight, we deal with that which is variable in all parts of the earth, and, owing to

atmospheric changes, variable at the same time almost in the same position. Doubtless all of us who have attained years of discretion have been asked the question in our earlier days, which was the heavier, a pound of lead or a pound of feathers. Here, in a glass case, is a bag of feathers (eiderdown), and a weight exactly balancing them. Call the weight a pound of lead, and then truly the pound of lead is balanced by the pound of feathers. Now, the scale beam is a delicate one, and accurately poised. By this pipe is admitted hydrogen gas into the case, the upper part of the case is closed, the hydrogen ascends, the air gradually escapes at the bottom, the scale-beam loses its equilibrium, and the bag of feathers descends, and is evidently heavier than the pound of lead.

This must for the present suffice to satisfy you that weight, as such, must not be considered an accurate measure, and that, somehow or another, a measure for mass must be obtained and used in the place of that which we call weight. These three units then—mass, space, and time—are sufficient for all purposes of measurement, and when reliable data have been furnished from whence these can be deduced, determined, and (if lost) restored, we shall be in possession of all that is required for the purpose of recording every measurement requisite for estimating and comparing the work done by the energy manifested by any one or more of the forces derived from "the imperponderables."

(To be continued.)

ON SOME FORMS OF LABORATORY APPARATUS.

By WOLCOTT GIBBS, M.D.

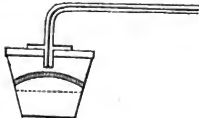
EVERY chemist knows how difficult it is to conduct an evaporation quantitatively in a porcelain or platinum crucible heated from beneath. The following simple contrivance which I devised some years since, and which



has long been in successful use in many laboratories in this country, deserves I think to be more widely known. It consists, as shown in the figure, of a hollow ring of metal, which can be moved up and down upon a vertical rod, also of metal, and which is provided with two stopcocks, by means of which air and gas may be admitted to the interior of the ring in proper proportions. The ring

has a series of fine openings so placed that the little blue jets of burning gas point radially toward its centre. The common water-blast may be employed with great advantage to give a continued supply of air; and, when the proper proportions of air and gas are obtained, which requires but an instant, the little tongues of blue flame remain constant for hours. A foot-bellows may also be employed when necessary. The crucible to be heated is supported upon the bottom of an inverted Beaufay crucible. The ring-burner is then adjusted so that the points of the little jets of flame play upon the upper edge of the crucible to be heated. After a short time the ring-burner may be lowered so as to heat a lower zone of the crucible, and so on until the outer rim of the bottom is ignited. In evaporations the ring must be more slowly lowered. With a very little practice solutions even of sodic chloride may be evaporated to perfect dryness without loss by decrepitation. Loss by the creeping of solution over the edges of the crucible is also prevented completely. In short, very numerous operations may be performed with the ring-burner more easily, quickly, and safely than by any other form of apparatus with which I am acquainted.

Another petty contrivance, which I find of great service, consists simply of a circular disc or meniscus of porous earthenware. In crucible ignitions, in which a current of gas is passed over the ignited substance—as, for instance, in reducing metallic oxides in hydrogen—great care must be taken to prevent mechanical loss. In such cases I place a porous capsule in the crucible above the substance to be heated, as in the figure. The gas may then be



introduced through the perforated cover by means of a porcelain pipe in the usual way and passes through the porous capsule by diffusion. Mechanical loss is thus completely prevented, as the soft capsule may readily be filed so as to fit the crucible accurately.*

My acknowledgments are due to Mr. W. E. Cutter for his most efficient aid in the prosecution of my work.

CORRESPONDENCE.

ON BUTTER.

To the Editor of the Chemical News.

SIR,—I entirely agree with "J. B." in his desire for the continuance of such useful papers as the "Testing of Butter." I have been a regular subscriber to your journal for some years, and would give such thoroughly practical and really useful articles a hearty welcome.

Without expressing any opinion whatever on the paper itself, I must say it is not fair to criticise any production in a sweeping manner. Mr. Wanklyn has certainly done his best to merit "silent contempt" from his opponent; but I trust Dr. Brown will reply, without noticing the satirical strain of the critique, and defend his position as a public analyst.—I am, &c.,

W. F. CATCHSIDE.

Snodland, near Rochester.
July 16, 1873.

* As an example of the utility of this little apparatus, I may refer to Mr. R. H. Lee's paper on the atomic weights of cobalt and nickel. *Am. Jour. Sci.*, vol. ii., July, 1871.

ON BUTTER.

To the Editor of the Chemical News.

SIR,—It appears to be necessary to inform Mr. Wanklyn that the glycerides of palmitic acid, butyric acid, &c., which are stated in the second paragraph of the paper on "Butter" (*CHEMICAL NEWS*, vol. xxviii., p. 1) to be the chemical constituents of butter, are the substances which Mr. Wanklyn calls palmitin, olein, butyrin, &c., in his courteous letter (vol. xxviii., p. 18).

Stearin can sometimes be obtained from butter, and sometimes not; but it does not occur in butter as crystallised stearin. When butter is fused at a low temperature the globules are still found on cooling. When it is fused at a high temperature they are not found on cooling; but the butter then has an imperfect crystalline structure, has lost its smoothness, and is very much depreciated in value: it does not exhibit crystals of stearin like those of lard and the mixture of refined fats known as "beurre de Paris," when examined by the microscope with polarised light.

No one is more sensible than I am of the imperfections of the scheme for examination of butter to which Mr. Wanklyn refers, yet I believe it is slightly better than any which has previously been published. When its results are negative, it does not prove the butter to be pure; when its results are positive, I believe they are reliable.

Mr. Wanklyn also has been working on butter; doubtless he could produce a much better method for proving admixture of refined fats with butter. Would it be too much to ask him to do so? Perhaps you, sir, would readily afford him the needful printers' ink.—I am, &c.,

J. CAMPBELL BROWN.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopaedic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the *CHEMICAL NEWS*, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, June 23, 1873.

Second Note on Guano.—M. Chevreul.—In this paper the author does not give the results of a substance forming long acicular crystals, but treats of the gas disengaged by the action of water upon hard portions of guano, and of a vitreous substance taken from a sample of guano at Havre. The gas in question proved to be carbonic acid. The glassy substance had a strong ammoniacal odour mingled with that of avic acid, and consisted mainly of phosphate of ammonia. Returning to the consideration of the ultimate analysis of manures as commonly practised for commercial purposes, the author remarks that he can conceive the utility of the present system if applied to the comparison of two samples of guano; but that he cannot conceive it at all when, e.g., a guano is to be compared as to its agricultural value with shoddy, bones, hair, or analogous substances. He insists especially on the power which guano possesses of giving off—when in contact with water—free carbonic acid simultaneously with the production of carbonate of ammonia. He contends that the peculiar odour of "avic acid" becoming more perceptible after that of ammonia

has disappeared, may serve as an indication as to the origin of alleged guano.

Researches on Chlorine and its Compounds.—M. Berthelot.—A thermo-chemical paper, bearing upon the controversy existing between the author and Prof. Thomsen. M. Berthelot details experiments on the behaviour of chlorine with water and with metallic proto-salts, showing what conditions the employment of chlorine in thermic measurements ought to fulfil, and throwing light on the *modus operandi* of chemical affinities. He examines the action of chlorine on water, on mercurous chloride, stannous chloride, and ferrous sulphate.

On Blast-Furnaces.—M. L. Gruner.—The author concludes—(1) That the yield of large blast-furnaces, beyond the bulk of 200 cubic metres does not increase proportionally to their capacity. (2) That up to a certain limit, variable with the state of the ore and of the fuel, there is an advantage in increasing the height of these furnaces, but that beyond this limit nothing is gained by an augmentation either of height or capacity. (3) That the minimum consumption corresponds to a mean speed of the general descent of the charge; that is to say a deficiency and an excess of the blast both equally lead to an increased consumption. In both cases there is a departure from the optimum progress of the furnace. (4) That the heat introduced by the hot-blast advantageously replaces that furnished by direct combustion near the tuyeres, but that the relative economy diminishes as the temperature rises higher. Beyond 700° and 800° the real economy becomes inconsiderable.

Production of Methyl Alcohol in the Distillation of Formate of Lime.—C. Friedel and R. D. Silva.—The authors, previous to the publication of the memoir of Lieben and Paterno on the same subject, had announced to the Chemical Society (Paris) in its session May 2, 1873, that the dry distillation of the lime salt of a new valerianic acid, mixed with an excess of formate of lime, yielded methyl alcohol. The same alcohol was also obtained by distilling the pure formate. Formic aldehyde was probably simultaneously produced, the characteristic odour of dioxymethylene being distinguishable. During the decomposition of the formate a considerable quantity of a gas was produced, one portion of which was absorbed by the chloride of iodine forming an oily product, doubtless chloriodide of ethylene and propylene; the portion not absorbed consisted of hydrogen. The fact above pointed out is a further instance of the analogy between those reactions which are called pyrogenous and those which take place at low temperatures: the nascent hydrogen behaves alike in both cases, and is capable of transforming by its fixation the aldehydes into alcohols.

On Terebin.—J. Ribau.—The author shows that the body commonly known as terebin is a mixture of cymen and of true terebin, the latter of which he has succeeded in isolating. It is a colourless liquid, mobile, of a faint peculiar odour. It does not congeal at -27° , and is less oxidisable than its isomer terebenthene. It boils at 155° to 156° at a pressure of 760 m.m., and its rotatory power is 0. Its composition is—

Carbon	88.24
Hydrogen	11.76

100.00

and its formula $C_{10}H_{16}$.

Production of Rotatory Power in the Neutral Derivatives of Mannite.—M. G. Bouchardat.—The author considers that the most natural interpretation of the facts he has observed is that mannite, a substance inactive in itself, and in which no known fact warrants us in admitting any rotatory power, by what process soever it may have been obtained or regenerated, cannot be split up into several optically active substances, but acquires in its combinations with acids, or by the fact of dehydration,

the power of acting upon the polarised ray. There seems thus to be a creation of rotatory power by the fact of combination.

New Researches on the Electric Effluve.—MM. Thenard.

New Series of Observations on the Solar Protuberances; New Researches on the Relation between Protuberances and Spots.—P. Secchi.—The author tabulates observations during four months, from Jan. 1 to April 22, thus completing two years. The spots and protuberances have diminished in number and size from a maximum in February to an absolute minimum observed in May, when the sun was several days without spots, and the protuberances were only five or six (being like woolly masses and without filaments). At time of writing (June 9), the activity was renewed. The author corrects M. Respighi's supposition that his interpretation of the absence of the chromosphere on the spots was only based on drawings; he was guided by direct observations. The question is, whether at these points the matter retires or advances; according to P. Secchi, it advances (*avance*). He has further experimented with the electric light and the absorbent power of metallic vapours. Projecting the solar spectrum on the light produced by sodium in combustion, he obtained a diffusion of the lines D_1 , D_2 , just as in the spots. The lines not only became broader, darker, and more diffuse, but a dark shade extended to right and left to a distance about twenty times that of the two lines. This shade he has also obtained with the spots. With iron and the electric light from a pile of fifty elements, he did not succeed in distinguishing the line λ_{74} K, though he counted more than 480 lines. Magnesium with the electric light gave lines greatly broadened and nebulous at the edge, and nearly touching each other, as had also been observed in a solar eruption of exceptional violence. Some lines in the blue he supposed to be from oxide of magnesium.

Influence of Atmospheric Refraction, relative to the Instant of Contact in the Transit of Venus.—M. Ed. Dubois.—A mathematical paper, with cuts.

Colouration and Greening of Neottia Nidus-Avis.—M. Ed. Prillieux.—This plant, of the family of Orchids, forms an exception to the rule that nearly all the phanerogams, having no chlorophyll, are parasites. Some time since, Herr Wiesner found that when the plant was kept in alcohol it took a green colour, which it afterwards gave up to the liquor. Hence he inferred that the exception was only apparent, the brown plant really containing chlorophyll, which, though masked, played the same part as in green plants. M. Prillieux finds that the little crystalline bodies of proteic matter, which form the brown colouration, are deformed when bathed in certain liquids, and that some liquids change both form and colour, producing the green colour. Not only solvents of chlorophyll (such as alcohol, ether, benzoin), but acids (such as hydrochloric, sulphuric, nitric) and alkalies (as potash) are capable of producing the green; heat also. A slip of *Neottia Nidus-Avis* put in boiling water soon turns green. If the greened plant be put in a liquor capable of dissolving chlorophyll, the characteristic properties of chlorophyll (optical, spectroscopical, &c.) may be observed. The author asks whether the chlorophyll pre-exists in the brown crystalline substance in the living plant. From some experiments he made, the conclusion seemed natural that it does not, but that when the crystalloids become green, the fact is that their substance itself is transformed into chlorophyll; not that a foreign matter, mixed with chlorophyll, is destroyed, and ceases to mask it. But he does not consider the point fully decided.

Semi-Diurnal Variations of the Barometer.—M. Broun.—These have been explained by currents of air rising from equatorial regions and going towards the poles. The writer cites some observations he made in Malabar and Comorand, and which are against this view. Thus, in the fine season, when the semi-diurnal oscillation of

the barometer at Malabar is greatest, there is perfect stillness at 6000 feet above the sea throughout entire days. Two facts must be recognised in theorising on the variation. One is, its change with the season in Europe. It is greatest in winter, and smallest in summer. In winter, the morning minimum is more marked; in summer, the evening. The variation during the day in summer resembles that during the night in winter, and *vice versa*. The other fact is, the change of the variation with height above the sea. From observations made by the author in India, it appears that, the nearer one approaches constant atmospheric conditions, the more nearly do the proportions between amplitude of semi-diurnal variation and total pressure approach a constant value. For places where there are not high plateaus, it may be said that, from 6000 feet, the oscillations are proportional to the total pressure for each station. The conclusions arrived at are—that the thermal hypothesis is to be rejected, and that the facts accord with the hypothesis of a polar attraction of the sun.

Study on Apparatus for Heating with Hot Air.—M. Ducrot.—From the theoretical point of view, the writer concludes that the quantity of calories furnished by the same apparatus, acting under the same conditions, is greater as the heated air issues at a lower temperature. By the same conditions, he means a constant external temperature, same quantity of fuel disposed in the same manner on the grating, burned in the same time with equal quantities of air. There is, however, for a piece heated with a given weight of fuel per hour, a maximum of temperature corresponding to a determinate quantity of air passing over the heating apparatus.

Constitution of the Sun and the Theory of Spots.—M. Vicaire.—Reserved for translation.

Polytechnisches Journal von Dr. E. M. Dingler,
No. 3, 1873.

What should be the Composition of a Good Drinking-Water?—E. Reichardt.

An Application of Aluminate of Soda in Calico-Printing.—A. Kiemayer.

Sensibility of the Haloid Salts of Silver to Light, with Alkaline Development.—H. Vogel.

Direct Preparation of Iron from its Ores.—S. v. Tanner.

Determination of Oxygen in the Gases of Lead-Chambers.—Fr. Bode.

On Graphite.—J. Stingl.

A New Process for the Manufacture of Stearin.—M. Bock.

Archiv für Pharmacie, May, 1873.

Preparation of Amygdalic Acid.—O. Müller.

Constituents of Cubebs, with especial reference to Cubebic Acid.—C. F. Schulte.

Photography on Dry Collodion Plates.—J. Schnaubs.

Moniteur Scientifique, du Dr. Quesneville, July, 1873.

On the Determination of Phosphoric Acid in all Products of Agricultural and Physiological Importance.—M. H. Joulie.—This paper, the conclusion of M. Joulie's interesting memoir, is not available for abstraction, but will be inserted in full at an early date.

Theory of Tanning.—M. A. Reimer.—A lengthy and exhaustive paper which we shall also endeavour to give in full.

On Perfumes, from a Physiological and Commercial Point of View.—James Paton.—A memoir read

before the North British Branch of the Pharmaceutical Society.

Toxicological Detection of Phosphorus.—We extract the following from a notice of Dragendorff's "Manual of Toxicology":—"The detection of phosphorus can be effected by two methods: we either seek to isolate it as such, or at least to exhibit its luminous properties; or, we endeavour to find its products of oxidation other than phosphoric acid (which, of course, is naturally present in the animal body. Mitscherlich's procedure is based upon the isolation of the phosphorus by distillation and the exhibition of its peculiar light. The suspected fluids are diluted, if needful, with water, and the homogeneous mixture introduced into a flask of sufficient size. Sulphuric acid is then added. The flask is closed with a cork, through which passes a tube bent twice at right angles, 2 or 3 centimetres in diameter and 5 or 6 long, and communicating with a Liebig's condenser of glass. Heat is then applied to the flask, and the process of distillation carried on in a darkened room. Luminous vapours appear in the flask as soon as the liquid is in ebullition. These vapours gradually ascend the tube, and become almost permanent at the spot where the first drops of watery vapour condense. Fresenius and Neubauer have recognised these luminous vapours for half an hour with a solution containing 1 milligram of phosphorus diluted to 200,000 parts. Huseman and Marmé introduced 1 c.c. of phosphuretted oil into the stomach of a rabbit, and obtained distinct luminous indications from the contents of the stomach, the animal having been killed five hours afterwards. The distillate may contain granules of phosphorus even when none can be recognised in the matters submitted to distillation. The process, however delicate, is not applicable in all cases. Certain products of putrefaction, creosote, sulphuretted hydrogen, alcohol, ether, and oil of turpentine prevent the appearance of the luminous vapours. The phosphorus may always be detected when in quantity sufficient to separate out in granules, but the presence of these foreign bodies may mask mere traces. In such cases the distillate is subjected to a further examination. Scheerer recommends to distil in a current of carbonic acid gas, in order to prevent any of the phosphorus being lost by oxidation. By this method, however, the valuable character of luminosity is sacrificed. It may happen that all, or most of the phosphorus, has been transformed into phosphorus or hypophosphorous acid, in which case little or no luminous vapour can be detected by the above-mentioned method. The vapours of phosphorus and hypophosphorous acids reduce salts of silver, and consequently blacken filter-paper saturated with an argentic solution. This reaction is so sensitive that when it fails we may be sure of the absence of phosphorus. The converse unfortunately does not hold good, since many bodies produce a similar reaction, e.g., formic acid and sulphuretted hydrogen. Hence Scheerer recommends the simultaneous employment of paper soaked in acetate of lead, which is blackened by sulphuretted hydrogen, but not by the acids of phosphorus. Fresenius and Neubauer have shown that ozone may give a brown colour to the lead-paper. It is, therefore, better to replace the lead with other test-papers prepared with nitro-prusside of sodium, arsenious acid, and chloride of antimony. The simultaneous colouration of these papers will show the presence of sulphuretted hydrogen, but will prove nothing as to the simultaneous presence or absence of the phosphorus acids. Scheerer proposes to search for phosphorus in the silver paper. It is to be washed with boiling water, the silver separated with hydrochloric acid, and phosphoric acid determined in the filtrate by means of molybdate of ammonia. It is better to dissolve the filter-paper in aqua regia. The only drawback to this process is the difficulty of procuring filter-paper absolutely free from phosphates. Dussard and Blondlot treat the homogeneous mass under examination with pure zinc and sulphuric acid. The gas generated contains phosphides of hydrogen, and burns with a characteristic green flame. The gas, before being

burnt, is freed from every trace of sulphuretted hydrogen by being passed through tubes filled with pumice steeped in potassa-lye. It should be burnt at a platinum orifice, for the yellow colouration of soda in the glass would otherwise mask the reaction. The hydrogens must not be mixed with arseniuretted or antimoniuiretted hydrogen. The presence of alcohol, ether, and other organic matters is fatal to the reaction. The green colour is more distinct by daylight than in a darkened room. Blondlot has remarked that the phosphuretted hydrogen disengaged gives a black precipitate, phosphide of silver, in solutions of nitrate of silver. The phosphide, placed in a suitable apparatus with zinc and hydrochloric acid, gives off a gas which burns with a green flame. In this manner he removes the organic matters which interfere with Dussard's procedure. The following is his method:—The suspected matters are converted into a homogeneous paste, and introduced into a roomy hydrogen apparatus with zinc and sulphuric acid. The gas is passed through a solution of nitrate of silver. The precipitate is filtered off, when it no longer increases in bulk, washed, and introduced into a small apparatus, and treated as above. This process occasions the loss of a part of the phosphorus. Fresenius and Neubauer have proved that merely two-thirds of the phosphorus are thrown down as phosphide of silver. These two chemists combine the two procedures of Mitscherlich-Scheerer and of Dussard and Blondlot. They first employ the method of Mitscherlich, or that of Scheerer, according as there appears to be more or less of the poison present. In some cases not merely distinct lumps of vapours are seen, but granules of phosphorus are isolated. As soon as these characteristics cease to appear, nitrate of silver is added to the condensed liquid, and the distillation is continued. The well-washed precipitate is introduced into the hydrogen apparatus. The purity of the zinc and sulphuric acid employed should be determined by a previous experiment. Fresenius and Neubauer have analysed a liquid (putrid blood and water), containing 1 milligram of phosphorus in 200,000. The first 400 c.c. of hydrogen presented the most characteristic reactions. The colouration was more feeble with the 400 next, and very faint but still perceptible with the 400 last. Christoffe and Beilstein recommend the examination of the flame with the spectroscope. The residue of the distillation may contain phosphorous acid formed by the oxidation of the phosphorus. It may be treated with zinc and sulphuric acid. Phosphoric acid is never decomposed in these conditions. The contrary is the case with the hypophosphites, which, being lately employed in medicine, may be the cause of errors.

Clarification of Beer by means of Tannin.—E. Brescius.—For 1000 litres the author employs about 140 grms. of tannin, dissolved in 0.75 litre of water, which is thoroughly mixed up. After three or four days he adds 1 litre of isinglass or 2 of gelatine in the proportion of 1 kilo. to two litres. The complete clarification requires about eight days.

On a New Method of Dyeing and Printing with Indigo.—P. Schutzenberger and F. de Lalande.—The energetic reducing action of hydrosulphite of soda, and its almost instantaneous influence upon indigo, which it converts in the cold into white indigo, has led the authors to study the practical employment of this salt in the various applications of indigo in dyeing and printing. The vats most commonly employed in modern times are the coppas for vegetable fibres, and the fermentation vat for wool. The chief inconvenience of the former is the presence of a bulky precipitate of oxide of iron and of sulphate of lime, which have to settle before the clear liquid can be used for dyeing. Fermentation vats are difficult to manage, and liable to sudden changes, which may in a few hours involve the loss of all the indigo contained. The hydrosulphite vat which the authors propose, as well for animal as vegetable fibres, is set as

follows.—Bisulphite of soda, standing at 30° to 35° Baumé, is brought in contact in a covered vessel with twisted sheet zinc or granulated zinc, filling up to the top of the vessel without occupying more than one-fourth of its real volume. After the lapse of about one hour the liquid is poured into an excess of milk of lime, which precipitates the salts of zinc. It is stirred, and the clear liquid drawn off either by filtration and pressure, or by decantation after the addition of water. Air should be excluded as much as possible. By mixing the hydrosulphite thus obtained with ground indigo and the amounts of lime or soda needful to dissolve the reduced indigo, we obtain at once a yellowish liquid containing no insoluble matter except the earthy impurities of the indigo. One kilogramme of indigo may be thus reduced so as to form a solution not exceeding 10 to 15 litres in volume. For dyeing, a certain quantity of the reduced indigo solution is run into a vat filled with water. This vat being clear in its entire depth, the operation of dyeing involves no loss of time. The excess of hydrosulphite constantly reduces the sum of oxidised indigo forming on the surface of the dye-bath, the strength of which can be kept up during working by successive additions of the concentrated indigo solution. Thus the required shade can be obtained with the smallest possible number of dips. This vat gives shades more solid and clear than can be obtained with the old vats, and enables the dyer to produce upon wool very light blue bottoms, which are ordinarily got by means of sulphate of indigo, and are in consequence much more fugitive. The process at present employed for printing indigo-blues consists in printing on white indigo, or indigo-talc of tin, obtained by precipitating a tin vat with hydrochloric acid, or by adding to the clear portion of a coppas vat a mixture of tin-salt and hydrochloric acid. The precipitate, thickened with gum, is printed on the calico, and then fixed with milk of lime. The goods are next passed through a chloride of lime bath, sulphuric acid, and soap. The process is difficult, delicate, and costly. Various attempts at improvement have hitherto failed in securing complete success. We may mention as examples the faïence blue, pencil blue, and printing with a concentrated vat in an atmosphere of coal gas, air being excluded. The authors propose to print with an alkaline solution of reduced indigo, suitably concentrated and thickened, containing a large excess of hydrosulphite of soda. The presence of this salt tends to keep the indigo-blue reduced which otherwise tends to become oxidised during the time of printing. This part of the process can be carried out in common air, and with an ordinary machine, the oxidation being so slight that after an hour's work the remnant of the colour is still yellow and soluble. By thus printing on reduced indigo immediate fixation is secured, and entire colouring matter is utilised. Experience has proved that, for equal shades, 50 to 60 per cent less indigo is consumed with the new process than with the old. The shades obtained are more beautiful and solid, and the impression is better defined. The new indigo blue, requiring no subsequent fixing process, can be printed along with a great number of other colours, such as aniline black, garancin, colours obtained by dyeing or steaming, catechu shades, chrome colours, colours fixed with albumen, &c. Thus new styles may be created which would be difficult to execute in any other manner. The blue printing colour is formed by thickening with gum or any other suitable material, a sufficiently concentrated solution of white indigo in an alkali, and adding to the mixture a sufficient quantity of hydrosulphite of soda. After printing, the pieces are hung up for twenty-four hours to oxidise, washed and soaped.

Revue Scientifique de la France et de l'Étranger,

July 5, 1873.

This number contains no chemical matter.

Neues Repertorium für Pharmacie, No. 5, 1873.

Valuation of Bone-Black.—J. B. Schober.

Solubility of Arsenious Acid in Water.—L. A. Büchner.

Autumnal Colouration of Leaves, and the Manner of Formation of Vegetable Acids.—C. Kraus.

Researches on Kirschwasser.—G. Brigel.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, par Ch. Méne, No. 25, April 25, 1873.

This number contains nothing bearing upon chemistry

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvement in the manufacture of the phosphates of soda and potash, and chloride of ammonium; also in the manufacture of chemical manures and alkalis. Robert Storr Best, Gole, Yorkshire. December 5, 1872.—No. 3567. I take phosphoric acid, derived either from aluminous phosphates, after the removal of the alumina, or from any source, and in definite proportions mix with potassium or sodium chloride, then saturate with ammonia, either from distillation of gas-water, or the destructive distillation, with lime, of wool refuse, leather, hair shavings, or other nitrogenous substances, then evaporate to crystals or dryness, and use the product at once as a highly concentrated manure, or recover the ammonium chloride by crystallisation or sublimation, leaving the potassium or sodium phosphate to be dealt with. I then, from a solution of the alkaline phosphate, precipitate tribasic phosphate of lime, by the addition of lime to the solution, having potash or soda remaining, which I evaporate to dryness. I then treat the precipitated phosphate with a further quantity of phosphoric acid, forming neutral phosphate, dry by mixture with calcium sulphate gypsum or salt of magnesia, and thus produce a very concentrated superphosphate of lime.

An improved apparatus for drying manure, cement, paper pulp, and other fluid or semi-fluid matters. William Hart and James Hart, Crossness, Kent. December 9, 1872.—No. 3734. This apparatus consists essentially of a revolving drum (the cylindrical part of which is perforated or reticulated) and other apparatus in connection therewith, such drum and apparatus being arranged as hereinafter described so as to separate the water from the matter to be dried and draw a coating of such matter on to the periphery of the drum, then to draw hot air through the coating to dry it, and then to force cold air through the dried matter to detach it. The drum consists of two parts mounted on a horizontal shaft, wire gauze being affixed to the edges of the disks to constitute strainers. The lower part of the drum works in a tank containing the matter to be dried. The upper part (except the strainer) where the dried matter is conveyed, is covered with a jacket through which hot air is introduced by a pipe leading from the heater to a trough affixed to the casing. The drum is divided into a series of longitudinal chambers which communicate with ports in a cylinder keyed on the drum shaft and outside the drum. This cylinder revolves in a stationary outer cylinder of such a diameter as to leave an annular space between the two cylinders. This annular space is divided into three chambers, termed respectively the water exhaust chamber, the hot air exhaust chamber, and the blast chamber. The water exhaust chamber communicates with a suction pump which draws the water through those of the chambers which are immersed in the matter to be dried, and causes a coating of such matter to adhere to the drum. The water drawn into the chambers is drawn therefrom through pipes and ports which communicate with the water exhaust chamber. The hot air exhaust chamber communicates with a suction pump which draws hot air through those of the chambers in which the matter is passing under the hot air casing, and thereby dries the coating of matter on the drum. The blast chamber communicates with a forcing pump which forces air through the longitudinal chamber in communication with the hot air exhaust chamber, and thereby causes the hot air to detach the dried matter from the drum. A brush or scraper is mounted on this part of the drum to complete the removal of the matter.

An improved insulating compound for telegraphic purposes. William Robert Lake, of the firm of Haseltine, Lake, and Co., patent agents, Southampton Buildings, London. (A communication from Zalmom G. Simmons, Kenosha, Wisconsin, U.S.A.) December 9, 1872.—No. 3735. This invention relates to the compound of materials for producing an insulating compound by means of which a more perfect insulation of telegraphic conductors is obtained than by the ordinary means; this compound is at the same time cheap and durable, and is not easily affected by the action of the weather. This compound is composed of one part coal-tar or its equivalent, and two parts charcoal or saw-dust, tan bark, or any other organic body having a fibre and being a poor conductor of electricity, and which may be ground or cut up to mix with the tar. The coal-tar is heated to a temperature at which the charcoal is introduced and thoroughly combined with it by agitating the entire mass by any mechanical means. The proportions may be varied.

An improved method of clarifying and straining varnishes, oils, and other like substances. William Robert Lake, of the firm of Haseltine, Lake, and Co., patent agents, Southampton Buildings, London. (A communication from Franklin Kersting, Grand Rapids, Michigan,

U.S.A., grainer and polisher.) December 9, 1872.—No. 3737. I take oyster shells, or other shells, and grind them to a fine powder, and then grind marble chips and dust to a powder also. These are thoroughly mixed together and thrown into a vessel containing the liquid. The mixture is then allowed to stand forty-eight hours, during which time all the dirt, muck, and gum specks of the liquid are allowed to settle to the bottom of the receptacle, and a new and improved varnish or article is thus produced for the trade.

Improvements in the treatment and utilisation of sewage water. Henry Young, Darlington Scott, Ealing, Middlesex, Major-General, C.B. December 11, 1872.—No. 3755. The objects of this invention are, economy in dealing with sewage, the effectual cleansing of the drains, and the preventing the generation of noxious sewer gases.

A new or improved motive-power engine adapted for use in gas-works. William Edward Gadge, patent agent, 51, Wellington Street, Strand, Middlesex. (A communication from Georges Thomas de Kercado, 64, Faubourg St. Martin, Paris.) December 12, 1872.—No. 3746. This invention relates to a motive-power engine actuated by soluble gases, such as chlorhydric acid gas, ammoniac or methyllic gas, or any gas having the property of dilating at a low temperature and condensing with equal facility. The soluble gas separates itself in a heated generator from the liquid which had dissolved it, and passes into a reservoir, from whence it is distributed to the cylinders, after acting upon the pistons of which it passes into a condenser, there re-uniting with the absorbing liquid, which, forced by the gas from the generator, has passed through a jacket surrounding the generator, and returns thence to the condenser. After complete absorption of the gas by the liquid, the solution made in the condenser goes to a receiver, and from thence to the generator, where the separation again takes place, the gas and liquid again make the same circuit, and are indefinitely repeated.

Improvements in the means and apparatus for conveying sewage and other liquid or partially liquid refuse from cesspools, privies, and other receptacles. Charles Denton Abel, 20, Southampton Buildings, Great Street, London, W.C. (A communication from Alexander Frederick Booroff, St. Petersburg, Russia.) December 13, 1872.—No. 3788. This invention relates to the arrangement, construction, and operation of apparatus for emptying cesspools and receptacles of excreta and other refuse and conveying the contents by pipes to localities where they may be discharged or utilised without permitting the escape of offensive emanations. For this purpose a system of pipes provided with valves is arranged underground communicating with the cesspools and other receptacles for sewage and other refuse, and leading to a discharging apparatus consisting of a well or shaft in which is a vertical steeled pipe communicating with the system of pipes and with an air-pump or other apparatus for producing vacuum in the pipes. The steeled pipe and the exhausting apparatus the sewage is made to flow down into the well, whence it is removed by a dredging machine or chain buckets. At the highest points of the sewer pipes closed receptacles are connected thereto, in which the refuse is deposited, and from which they are conducted to burners for consuming them. The sewer pipes are connected with the water mains for the purpose of filling them with water at starting, and for flushing the pipes when required.

Improvements in the manufacture of hydrogen gas. James Frederick Lakersteen, civil engineer, 3, Lombard Court, London. December 17, 1872.—No. 3829. The specification of this invention describes a method of manufacturing hydrogen gas by passing foul gases acidulated or otherwise, through or over heated manganese, or any suitable compound thereof, by which means the steam is decomposed, the oxygen being absorbed by the manganese, and the hydrogen set free, to be conveyed away by any suitable means, and used for whatever purpose it may be required.

NOTES AND QUERIES.

Lemon-Chrome.—(Reply to L. C.)—I think if L. C. add a little potassic carbonate to the chrome before mixing with the lead solution, it will cause a less shaded shade of chrome, and the use of potash used was not quite neutral; this would render it so.—H. C.

Chrome Yellow.—Can any of your readers inform me what substitute can be used for nitrate or acetate of lead to precipitate bichrome of potash yellow? The Germans are now making a yellow pigment without using lead, and if you can put me upon the track I shall feel obliged.—C. G. C.

Anthracen.—I shall feel greatly obliged if any of my fellow readers will inform me of a good reliable method for estimating the percentage of anthracen in commercial samples. I am acquainted with the method by use of anhydrous alcohol, but experience has shown that the results are very crude samples. Also, if I could be informed of the colour of pure anthracen, and correct fusing-point I should be obliged.—D. W.

Safety at Sea.—The recent sudden destruction of two large passenger ships, the *Atlantic* and the *City of Washington*, has called attention to the desirability of availing ourselves of the means which modern science has placed at our command for the prevention of such disastrous accidents. For this purpose, each large passenger ship should carry a small, but powerful steamboat or launch, and in foggy weather this steam launch should be sent on ahead some few hundred yards, being connected with the passenger ship by a flexible telegraphic cable provided with an electric battery, so that signals or messages might be continually transmitted from one to the other. The steam-launch should also carry an electric or pneumatic alarm, and be provided with a powerful steam whistle. On meeting with ice or with vessels, or unexpectedly approaching the coast, it would be comparatively easy to stop the steam-launch and give warning in time to save the passenger ship from danger.—John Newland, N. C. S.

* The spelling is the patentee's.

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THE CHEMICAL NEWS.

Vol. XXVIII. No. 713.

THE POLLUTION OF RIVERS BILL.

THE Earl of Shaftesbury has presented to the legislature a Bill, bearing the above title, and embodying the water-clauses, which were struck out of the Public Health Bill before it became law last session.

As will be remembered, serious objections were raised against that portion of the Public Health Bill which relates to the Pollution of Rivers, and Mr. Stansfeld was so convinced of its impracticability that he publicly repudiated it, and excused the Government at the expense of the Rivers' Commission.

On behalf of the great majority of English chemists we protest against the resuscitation in the House of Lords of recommendations of the Rivers' Commission, which were expunged from the Public Health Bill, and repudiated by a responsible minister of the Crown.

These recommendations are as follows. We quote them from the printed draft of the Earl of Shaftesbury's Bill, which lies before us.

"Clause 7. For the purposes of this Act the following liquids shall be declared to be polluting (that is to say):—

"(1). Any liquid containing in suspension more than 3 parts by weight of dry mineral matter, or 1 part by weight of dry organic matter, in 100,000 parts by weight of the liquid :

"(2). Any liquid containing in solution more than 2 parts by weight of organic carbon, or 0.3 part by weight of organic nitrogen in 100,000 parts by weight of the liquid :

"(3). Any liquid which exhibits by daylight a distinct colour when a stratum of 1 inch deep is placed in a white porcelain or earthenware vessel :

"(4). Any liquid which contains in solution in 100,000 parts by weight more than 2 parts by weight of any metal, except calcium, magnesium, potassium, and sodium :

"(5). Any liquid which in 10,000 parts by weight contains, whether in solution or suspension in chemical combination or otherwise, more than 0.05 part by weight of metallic arsenic :

"(6). Any liquid which, after acidification with sulphuric acid, contains in 100,000 parts by weight more than 1 part by weight of free chlorine :

"(7). Any liquid which contains in 100,000 parts by weight more than 1 part by weight of sulphur in the condition either of sulphuretted hydrogen or a soluble sulphuret :

"(8). Any liquid possessing an acidity greater than that which is produced by adding 2 parts by weight of real muriatic acid to 1000 parts by weight of distilled water :

"(9). Any liquid possessing an alkalinity greater than that produced by adding 1 part by weight of dry caustic soda to 1000 parts by weight of distilled water :

"(10). Any liquid exhibiting a film of petroleum or hydrocarbon oil upon its surface, or containing

in suspension in 100,000 parts more than 0.05 part of such oil."

The Bill proposes to punish persons who discharge into streams, liquids answering to the above descriptions. When this matter was under discussion last year the futility of merely estimating the strength of a discharge was pointed out, and it was shown that the effect of such a course would be to put manufacturers to inconvenience and inflict injury upon them. And, as will be remembered, deputations of manufacturers waited on Mr. Stansfeld, to urge upon him the damage which would be done to the industries of the country if the Bill, in its unamended form, came into operation.

We will now take up the subject of the definitions of what constitutes a polluting liquid, and show how injudicious are the above-quoted recommendations, and how impossible it will be to attend to them in practice.

According to the first definition in Clause 7, no liquid must flow into a river if it has suspended in it more than 3 parts of mineral matter in 100,000.

We remind our readers that the Thames sometimes contains 50 parts of suspended matter in 100,000; the Rhine at Bonn 20; the Meuse 47; the Ganges 20 to 200; the Seine 12; and the Mississippi 80. The last river is said to carry down annually to the sea no less than 4000 million cubic feet of clay.

As was pointed out by the Marquis of Salisbury, any ditch draining into a river might entail penalties on landowners, provided the water in the ditches was not purer in this respect than some of the greatest rivers in the world. Indeed, the Bill would entail the penalties on the owner of *one end* of the ditch.

Definition 2, prohibits more than 2 parts of "organic carbon," or 0.3 part of "organic nitrogen" in 100,000 parts of the discharge. Let us examine this.

London sewage consists mainly of the day's excreta mixed with 30 gallons of water per individual. Taking the day's urine to be 3 lbs. (which is rather a high average), it would, therefore, appear that the urine is diluted with 100 times its weight of water, in order to make London sewage. Urea is very rapidly transformed into carbonate of ammonia, and sewage contains little or no urea, but instead of it the carbonate of ammonia arising from its transformation. In addition to urea, urine contains other nitrogenous matters which are comparatively permanent, and which pass undecomposed into sewage. Now it is a fact which admits of deduction, and which has likewise been confirmed by experiment, that London sewage—such as is discharged by the Fleet Ditch sewer and at Barking—does not contain more organic nitrogen than 0.3 part per 100,000.

No evidence has been laid before the public, or the scientific world, as to the precise numerical limits adopted in the definitions; nor proof that the evil effects of the various impurities specified stand in the exact proportions implied in Section 7. Where is the proof that "organic nitrogen" is safe up to the limit specified, and unsafe beyond? Failing such proof, the recommendations savour of empiricism, wearing the mask of scientific precision.

The use of the terms "organic nitrogen" and "organic carbon" is objectionable, because it implies an official recognition of the process of water-analysis devised by one of the Commissioners, but condemned by the chemical profession as impracticable and fallacious.

The term "organic nitrogen" confounds substances totally distinct in a sanitary point of view. Thus it would include—

- a. Bodies such as *urea*, which is resolved on decomposition into carbonate of ammonia, and which is no more dangerous to health than pre-formed ammoniacal salts, or alkaline nitrates and nitrites.
- b. Bodies like the organic alkaloids, which obstinately resist putrefaction.
- c. Bodies like albumen, gelatin, casein, &c., which rapidly pass into the most offensive phases of decomposition.

To group under one head two bodies so utterly dissimilar in their sanitary bearings as *urea* and albumen, merely because they both contain nitrogen, is to violate the fundamental laws of scientific classification. Any regulation which ignores such important distinctions must be misleading and dangerous. It is therefore suggested that for the term "organic nitrogen" the more precise term "*albumenoid ammonia*" should be substituted; that is to say, nitrogen present in the form of albumenoid bodies, estimated by the amount of ammonia which they yield.

Similar objections must be taken to the term "organic carbon." It, also, confounds bodies incapable of putrefaction with others exceedingly liable to change, and certain to yield offensive products. Thus, should *alcohol* enter a river, it would neither putrefy nor aid in the multiplication of germs, whilst *starch* would do both. Yet these two bodies would be grouped together as yielding organic carbon.

The third definition would exclude probably all ditches and small brooks, most mountain streams, and many of the most beautiful mountain tarns, for they are frequently sufficiently tinged with peaty extractive matter to succumb to this test. Indeed we are not certain that the water of Bala Lake, from which London was to have been supplied, would always pass this ordeal. Constant disputes would be caused by the impossibility of deciding what was a "distinct colour." One authority would certainly prohibit what another would allow to pass; and if, as we understand is the case, it was the intention of the Rivers' Pollution Commissioners, in drawing up their regulations, to make this clause sufficiently lenient to pass a peaty stream which has the appearance of coffee when viewed in a stratum a foot thick, we can only say that they made a most unfortunate choice of language in which to express their meaning.

Definition 4 is levelled against noxious metals. With the exception of potassium, sodium, calcium, and magnesium on the one hand, and of arsenic on the other, this regulation places all metals on an equal footing. No more stringent rule applies to poisons—such as copper, lead, chromium, &c.—than to aluminium and iron, which are practically harmless. Copper, lead, chromium, &c., should be prohibited as strictly as arsenic. Iron and aluminium occur in many natural springs to a greater extent than these definitions would permit. There is no valid reason why all metals except calcium, magnesium, potassium, and sodium should be excluded if they exceed 2 parts in 100,000. What, for instance, is the objection to strontium? And why should barium, chromium, lead, and copper, all well-known and formidable poisons, be permissible in any

amount below 2 parts in 100,000 of water? There is no special provision against the admission into streams of *phosphoric acid*, which, though innocent in itself, powerfully aids in the promotion of putrefaction and in the multiplication of the lower forms of animal and vegetable life.

Definition 6 certainly requires qualifying. In a clear stream, abounding with fish and water plants, a little chlorine might be an objection. But, considering the filthy state in which most of our large rivers find themselves, we think the endeavour at present should be to induce manufacturers to throw as much chlorine into the river as they are willing to waste, and not to fine them unless they keep it out.

The "definitions," whilst laying down rules for the strength in noxious matter of any sewage, &c., flowing into a river, totally overlook its volume and the ratio it bears to the volume of the river. By this oversight the whole scheme may be entirely stultified, for it is evident that a million gallons of waste liquor thrown into a good sized river may do less harm than a thousand gallons discharged into a small stream.

Again, the act will be easily evaded where it is of most consequence it should be strictly enforced. Take the case of two large manufacturers, A and B, each discharging the same volume and quality of polluting liquid into a river. Let A be situated at the head of a stream, taking the water pure and undefiled as it gushes from the mountain side. Here, if any where, the proposed act should be stringently operative, for any offensive liquid thrown into the river pollutes it throughout its whole course. Accordingly clause 10 of the Act is put into operation, and the offending manufacturer receives written notice from the pollution authority to discontinue the discharge of polluting liquid within twelve months. What will the manufacturer do? He will merely divert a little more of the mountain stream into his works, dilute his waste liquors with the pure water down to the requirements of the law, and snap his fingers at the Act of Parliament. Now it is obvious that such a procedure, though it would literally fulfil the law, would leave the stream as polluted as before, since the total amount of impurities thrown into it would remain undiminished, and would bear the same ratio to the volume of water in the river.

But his fellow transgressor, B, situated 50 miles below on the same stream, will be unable to evade the penalty in this easy manner. His waste liquors, it is true, do not come up to the specified standard of purity; but as the river into which he drains has already passed through three or four large towns, and received the waste liquors of some hundreds of manufactories, it is even less able to conform to the Act. Here the waste liquor discharged by B actually does good rather than harm, inasmuch as it is less impure than the river into which it flows. It is obviously out of B's power to adopt the artifice employed by A, and he accordingly gets fined although his waste liquor is better than the river into which he discharges it, and he cannot therefore dilute it down to the required strength.

Instead of fixing upon a fanciful standard of purity which could never be attained in practice, common sense decides that a waste liquor is fit to be discharged into a running stream if it contain a less percentage of impurity than the water of that stream: the word "impurity" being not strained beyond its

legitimate meaning, or made to include perfectly harmless constituents. A manufacturer at the head of a stream would, it is true, have some difficulty in complying with this requirement, but it would only be fair that one drawing pure water near the source of a river, and then polluting that river throughout its whole course, should be judged by a severer standard than if he were to do exactly the same thing fifty miles below, where the river water, as he received it, was already polluted.

In the case of the highest, one or two works on a river the above rule would fail, and some modification must be introduced; but it would not fail until the natural working of the rule had so far purified the rivers of England as to have carried out, to all intents and purposes, the objects of the proposed Act.

Another great advantage of some such elastic, self-regulating rule as the one sketched out above would be that its action would be gradual. The purification of a river would take place by imperceptible gradations, extending over perhaps a year or two, without pressing hardly on any one. In this way time would be allowed manufacturers for making arrangements

to purify their waste liquids; and as the river gradually increased in purity by the natural working of these regulations, we have little doubt that the progress of science, and their own increased experience, would enable manufacturers in almost all cases to keep their effluent liquids up to the necessary standard.

COMPARISON OF BUTTER WITH OTHER FATS.

By J. CAMPBELL BROWN, D.S.C.

THE proportions of the chemical constituents vary so greatly (from zero upwards) that no reliable evidence of purity or impurity can be obtained by estimating the different fats obtainable by decomposing butter. In fact, the distinction between pure butter and butter mixed with flesh-fats is no more a chemical one than the distinction between different animals or different plants. The physiologist distinguishes one kind of tissue from another more readily by their microscopic characters than by their chemical composition; and microscopic examination with polarised light is the most reliable means of distinguishing pure butter from that which contains an admixture of less easily digestible and less palatable fats.

No.	Designation.	When Heated		On Cooling		Solid at Fahr.	Examined by a Microscope with Polarised Light and Selenite Plate.	Curd and Salt in grs. per oz.	Weight per oz.	Fuses Solidified at 65°.	
		Softens at Fahr.	Melts at Fahr.	Obs. at reading.	Stem in tin.					Fahr.	Fahr.
10.	Newly-made butter, from town-feds cows	69	76	83	76	73	Nothing is seen except globules and curd.	—	2.6	137	118
	The same salted ..	69	75	83	75	74	Globules, particles of curd; cubical crystals of salt.	32.5	—	—	—
8.	Irish butter	75	89	73	71	69	Globules, curd and salt; does not polarise. After being kept for nine months does not exhibit any crystals which polarise light.	—	1.7	133	114
4.	Irish butter, best quality	69	80	78	74	71	Globules, curd and salt. After being kept for eight months, exposed to sun, is white, but contains no crystals which polarise light; nor after being melted.	30.8	3.0	134	115
99.	Irish butter, low quality	76	89	82	77	74	—	17.7	19.1	131	105
1.	Cornish butter ..	72	80	80	78	72	—	24.1	8.6	129	110
6.	Canadian butter ..	74	90	71	69	68	Globules, curd; large crystals of salt, very numerous. The only things visible which polarise light are a few hairs and fibres. After being kept a year, exposed to changes of temperature and light, exhibits the same characters.	39.0	2.4	130	105
60.	Canadian butter ..	73	89	72	70	68	Globules, curd; large and numerous crystals of salt; magnesium salts; a few fibres. After eight months is decomposing, but contains no fat crystals which polarise light.	42.0	9.0	128	110
5.	Kiel butter	75	90	74	72	71	Globules, curd, and small crystals of salt. Is highly coloured. After eight months presents the same characters. Does not polarise light after being melted and cooled.	24.9	11.2	120	102
47.	Suspected butter ..	81	96	106	84	76	Globules, curd; cubical crystals of salt; stars and other crystals of fat which polarise light.	15.3	37.0	122	102
11.	Lard	84	96	—	—	96	Stellar and fusiform crystals which polarise light.	—	—	—	—
7.	Lard	79	87	80	79	76	Full of crystals which polarise light.	—	3.6	128	102
14.	Lard	87	96	80	79	78	Stellar masses which polarise light.	1.3	62.7	123	100
2.	Palm oil	81	92	—	88	80	Corpuscles and radiating masses of crystals which polarise light.	—	(temp. 60°) None from 2 ozs.	—	—
3.	Stearin from palm-seeds (is really palmitin)	83	83	65	93	88	Crystals which polarise light.	—	{ None from 2 ozs.	—	—
	Stearin from tallow	105	118	95	94	93	{ Stars and radiating masses of crystals which polarise light.	—	140.0	134	121
	Butter with 20 per cent lard	82	96	86	84	76	Globules, curd; salt; broken stars which polarise light.	31.8	37.7	128	98
	Butter with 20 per cent tallow. Stearin free from taste	88	99	79	77	76	Globules, curd; salt; and minute stars which polarise light.	24.7	55.3	135	115
	Butter with 50 per cent dripping ..	82	93	92	81	75	Globules, curd; salt; colouring matter; stars and other crystalline particles which polarise light.	19.0	43.8	136	113

A NEW THEORY OF THE FIELD OF VIEW AND MAGNIFICATION OF OPTICAL INSTRUMENTS.

In a recent number of *Poggendorff's Annalen*, Prof. Lubimoff, of Moscow, calls attention to an error which has long passed current in text-books on physics. It is generally said that the field of view of the Galilean telescope is dependent on the size of pupil of the observer's eye, and is measured by the angle subtended by the pupil's aperture from the middle of the objective. In this way it is represented as being five or six times less than it actually is. He quotes from various text-books, those of Wüllner, Pouillet, Müller, Reis, Daguin, Potter, and others, in illustration of his statement.

The error he traces to Euler, who wrongly applied to the case of a concave eye-piece, a principle which holds good in the Keplerian telescope. The central rays diverge from the centre of the object-glass, as from one point, and are united in a point where the eye-piece, if a convex lens, gives an image of the aperture of the objective. If the eye is in this position, it receives all central rays which fall on the eye-piece; hence the latter operates with its whole aperture. As, with a concave eye-piece, the central rays diverge, the eye, when applied to it, receives only so many rays as pass through the aperture of the pupil. This remark, the Professor points out, is quite correct with reference to central rays, but does not warrant a conclusion as to the field of view, for a considerable portion of the image on the retina is formed without central rays, and only by the side parts of the object-glass.

We propose to follow the author in the elucidation of his views on this subject.

To understand the true theory of the phenomenon, it may be well to resort to a principle which is often of use in explaining the elementary theory of images. This is, that we regard the image-forming apparatus (lens or mirror) as an aperture or a window, and the image itself as an object placed behind the aperture, and looked at through it. Apply this principle to the Galilean telescope. When we look through the telescope we see a bright circle before us, in which several objects appear, and which plays the part of the supposed window. What is this circle? It is easy to understand that it is no other than the subjective image of the object-glass aperture, produced through the dispersive eye-piece. (The size of the diaphragm may here be regarded as identical with that of the subjective image.) As, now, from the middle point of a lens, every object is seen under about the same angle as its image, we may take as approximate measure of the angular size of the diameter of the bright window (the eye being at the optical middle point of the eye-piece), the quotient obtained by dividing the diameter of the objective from the eye-piece, say $\frac{D}{\Delta}$; Δ being, according to the theory of the telescope, equal to the difference, $F_1 - F_2$, the focal distances of objective and eye-piece. Expressed in angular measure, the quotient will be—

$$\frac{360}{\pi} \cdot \frac{D}{F_1 - F_2}$$

If we looked at the object through a window of the same angular size as the bright circle with the naked eye, this number of degrees would directly express what is the greatest part of the entire circle of external objects we can see at once. To determine this practically it might be well to remove objective and eye-piece, and, without altering the position of the eye, look through the empty tube. Now, as the telescope magnifies n times, i.e., we shall, with the telescope, view through an aperture of the same visible size as formerly, an n times smaller part of the external circle of objects. To find the true field of view of a Galilean telescope, therefore, the above ex-

pression must be divided by n , or by $\frac{F_1}{F_2}$; as, according to telescope theory, n is about equal to this proportion. Hence the field of view is—

$$\frac{360}{\pi} \cdot \frac{D}{F_1 - F_2} \cdot \frac{F_2}{F_1}$$

The relation shown to exist between field of view and magnification affords a ready method of estimating the latter. One has only to look with the naked eye through an aperture, whose visible size is equal to that of the bright circle, and to compare the included space with that seen through the telescope (e.g. to count how many windows in a building, seen through an aperture, and seen through a telescope).

The theory asserts that the field of view of a Galilean telescope is immediately dependent on the size of aperture of the objective.

It can be shown what part of the objective shares in the production of a given part of an image, and the following mode of doing so gives a new point of view as to

FIG. 1.

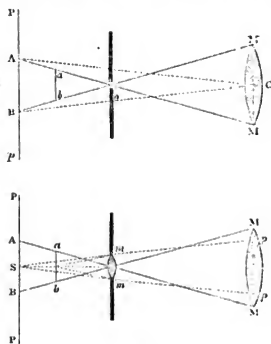


FIG. 2.

the theory of the telescope. Let $M-M'$ (Fig. 1) be the objective, $P-P'$ its focal plane, in which distant objects are imaged. Bring between the objective and the plane a diaphragm with small opening. The image will be formed as before; only that each point of the image is no longer produced through the union of all the rays of a conical bundle, having the whole objective as its base; but only by that part of the bundle which passes through the small opening, and may be regarded as a single ray. Thus, for a given point of the image, only that small part of the objective will send rays which correspond to the straight line going from said point through the opening to the objective. The limits of the image will be determined by the lines $M-A$ and $M-B$. Now, substitute for the diaphragm a Galilean eye-piece, behind which is the observer's eye. The phenomenon is in its main features the same; for we may regard the eye as a dark chamber, on whose further wall (the retina) the image is formed. The optical part of the eye and the eye-piece merely serve to make the retinal image distinct, and may, for theoretical treatment, be replaced by a lens fixed in the widened part of the diaphragm ($m-m'$, Fig. 2). The difference between the action of such a lens and that of

the small opening lies in this, that the image is distinct in the former case only when the screen stands at a particular distance, and that nearer to the lens than its focal plane, $P P$, e.g. at $a b$. And the same angle will correspond to both images. That part of the objective which shares in the production of a given image-point, will be determined by the lines drawn from said point to the edges, $m m$, of the lens, and prolonged thence to the objective. Corresponding to the contour of the supposed lens, we must evidently take the pupil aperture of the observer's eye. Let x be the diameter of the pupil, x that of the operative part, $p p$, in the objective, the size of this latter will be determined approximately by the equation—

$$\frac{x}{F_1} = \frac{F_2}{F_1 - F_2}$$

The foregoing contains the entire theory of the Galilean telescope. The retina is the flame which receives the image, $a b$. As this image is inverted, like all retinal images, we see the objects upright. The visual angle, under which the part of the visible circle imaged in $a b$ appears, is determined by the lines drawn from the middle point of the lens, $m m$, to a and b , or (the same thing) to A and B , and is measured by $\frac{AB}{F_2}$. The visual angle under which the same portion of visible space would appear to the naked eye, supposing this to be at the middle point of the objective, will be determined by the lines drawn from this middle point to A and B , and measured by $\frac{AB}{F_1}$. The proportion of these two angles is the magnification—

$$n = \frac{F_1}{F_2}$$

As through the telescope we only see, at once, that part of the outer circle whose image in the focal plane of the objective extends over AB , the expression—

$$\frac{360^\circ}{2\pi} \cdot \frac{AB}{F_1}$$

gives us directly the value of the field of view. But—

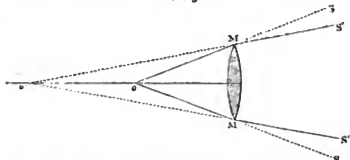
$$\frac{AB}{D} = \frac{F_2}{F_1 - F_2}$$

where D denotes the diameter of the objective, and $F_1 - F_2$ the distance between it and the point at which are eye and eye-piece. Thus we obtain the expression formerly given for the field of view:—

$$\frac{360^\circ}{2\pi} \cdot \frac{D}{F_1 - F_2} \cdot \frac{F_2}{F_1}$$

Finally, we may find the value of the field of view immediately, as follows:—Suppose, instead of the objective, a simple aperture, $m m$ (Fig. 3). Then the eye, being at o ,

FIG. 3.



would perceive the portion of space which corresponds to the angle $s o s$, and the rays $m o m o$ would come from the outermost visible objects, lying in the directions $s o s o$. In consequence of refraction in the objective the rays, $m o m o$, proceeding to the eyes, do not form a straight prolongation of the rays, $s' m s' m$, which meet, not in o , but further on, at o' , at the distance x from the objective.

Consequently, the limits of visible space are determined by the angle $m' o' m$. The side of the field of view will be equal to—

$$\frac{D}{x} \cdot \frac{360^\circ}{2\pi}$$

The distance, x , is obtained by the formula for conjugate foci; as o and o' are conjugate foci, then—

$$\frac{1}{F_1 - F_2} - \frac{1}{x} = \frac{1}{F_1}$$

Hence the field of view is, as before,—

$$\frac{360^\circ}{2\pi} \cdot \frac{D}{F_1 - F_2} \cdot \frac{F_2}{F_1}$$

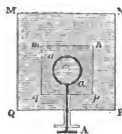
Prof. Lühmoff further shows how the same theory applies to the Keplerian telescope.

He next discusses some optical illusions, which permit of being explained by his theory of optical windows.

It is known that a convex lens magnifies objects placed behind it at a distance smaller than the focal distance. It has probably been observed by many that when, with distance of lens from object unchanged, we move away from the lens, the object seems to grow larger, especially if it is in the neighbourhood of the focus, and, e.g., consists of a series of dark lines on a white ground, as lines in a book. Judging from first impressions, it is difficult to believe that this obvious increase of the object is an illusion, and that, in reality, the size of the image on the retina—or, in other words, the angle under which the object seen through the lens appears to us—is diminished when we move away. This is indeed the case, however; the magnification is only apparent. An experiment like the following is fitted to show this. Behind the lens, $a a$ (Fig. 4), at a distance shorter than its focal, stands a pasteboard screen, $m n p q$, on which a number of parallel equidistant lines are drawn. Behind this screen is a second and larger one, $m' n' p' q'$, placed at the distance at which, according to the theory, that portion of the smaller screen seen through the lens appears to be. It is further understood that the lines drawn on the larger screen stand as far apart as, apparently, do the lines of the first screen seen through the lens. In this case that part of the screen ($m n p q$) which is visible through the lens will have the same appearance as the directly seen borders of the screen, $m' n' p' q'$; and if one of the lines seen through the lens coincides with one of the lines on the larger screen, all the other lines seen through the lens will also correspond with lines on the larger screen. Now it appears, from experiment, that on moving away from the lens this coincidence continues. At the same time we observe that the number of lines visible through the lens is diminished.

The cause of the apparent enlargement referred to (on withdrawing from the lens) lies in the fact that while in

FIG. 4.



one position, perhaps, 14 lines are visible; if the eye is further removed, only 8, 5, &c., lines are visible in the same field of view. Without reckoning for the distance of the eye from the screen, the observer arbitrarily infers—from the different number of lines in the field of view—that their distance from each other is altered, this distance appearing greater where few lines are visible.

A curious observation may be made in the act of reading. When we look through an opening at the lines in a book, placed not far behind the opening, and when we move away from it, the letters appear at first (and so long as we can read) clearly diminished; when, however, light has become indistinct, and we can no longer read, the lines and their distance from each other appear to increase, just like the lines on the screen in the former case. So long as we are able to read distinctly, we pronounce judgment on the distance of the book and the size of the letters, according to the greater or less difficulty we have in reading; beyond this, however, we draw the same inference as in the case of the screen.

A. B. M.

CORRESPONDENCE.

ON BUTTER.

To the Editor of the Chemical News.

SIR,—The conclusion which I drew when I read through Dr. Campbell Brown's paper "On Butter," viz., that the author of it appeared "not to know that butter resembles suet, tallow, dripping, and lard, by containing, as they do, stearin, olein, and palmitin, and that it differs from them only by containing very small quantities of butyric, &c.," has doubtless seemed rather harsh to some of your readers. Dr. Brown's letter, however, confirms my construction of his paper. As there seem to be persons who call for a detailed criticism in this instance, and who, with Mr. Catcheside, appear to require a more explicit statement, I will enter into particulars.

Touching stearin. This fat is well known to chemists to be of very frequent occurrence. In butter it was found by Chevreul long ago, and more recently by Heintz; and its existence in butter is generally admitted by chemists, as may be seen on looking into chemical text-books or into "Watts's Dictionary."

Now in Dr. Campbell Brown's paper (*vide* CHEMICAL NEWS, vol. xxviii., p. 1) butter is defined as follows:—"Chemically it consists of a mixture of neutral fats, the glycerides of the non-volatile acids, palmitic acid ($C_{16}H_{32}O_2$), and butyric acid ($C_4H_8O_2$); and the glycerides of the volatile acids, butyric acid ($C_4H_8O_2$), caproic acid ($C_6H_{12}O_2$), caprylic acid ($C_8H_{16}O_2$), and capric acid ($C_{10}H_{20}O_2$).—(Wagner and Crookes). The last four glycerides are the characteristic fats of butter." Thus Dr. Brown enumerates six glycerides as constituents of butter, but omits to mention stearin, the glyceride of stearic acid. It will probably be suggested by charitable chemists that all which follows from this circumstance is that Dr. Brown forgot to put stearin on the list. A further examination of the paper led me to reject this hypothesis; and Dr. Brown's letter will, I think, be admitted—even by Mr. Catcheside—to have excluded any such explanation.

Dr. Brown now writes that "stearin can sometimes be obtained from butter and sometimes not; but it does not occur in butter as crystallised stearin."

I do not think I need make any further comment on this statement. Touching olein, this compound, which is the glyceride of oleic acid, is mentioned by Dr. Brown as existing in certain fats, such as beef suet, &c., but is not mentioned among the constituents of butter. Instead of it, the glyceride of what Dr. Brown calls butyric acid—an acid to which the formula ($C_{12}H_{24}O_2$) is assigned—takes its place. Some chemists may suggest that the name is an eccentricity, and the formula a misprint; but in his letter Dr. B. does not correct the formula.

With regard to palmitin, Dr. B. says in his paper that palmitin is one of the most characteristic ingredients of suet, &c., and leaves us in doubt whether or not he believes it to exist in butter; the glyceride which he attributes to butter being the glyceride of palmitic acid (instead

of palmitic acid). A tolerably correct knowledge of the constitution of butter is an indispensable preliminary to the detection of the adulterations of butter. With the hint that there is nothing improbable in the separation of impure stearin from butter placed under certain obvious physical conditions, I will therefore close my letter.—I am, &c.,

J. ALFRED WANKLYN.

London, July 19, 1873.

ON BUTTER.

To the Editor of the Chemical News.

SIR,—In estimating the water in butter, the presence of dripping can also be detected at the same time, by the peculiar odour of roast meat, and any one with a keen sense of smell can say whether beef or mutton dripping is the adulterant.

In the elaborate and interesting analysis of butter which Dr. Brown has given us, there is work enough for at least two days, particularly as a pure sample of butter has to be analysed along with it. May I ask, is it necessary for every Public Analyst to make such a minute examination? Surely the presence of dripping, starch, or any foreign matter, is quite sufficient to produce a conviction, without being obliged to state the quantities; and the low fees which are paid for these analyses utterly preclude such elaborate examinations. For instance, Dr. Cameron has just been appointed Analyst to the County of Sligo, with the liberal salary of £25 a year, and weighted with this addition—that the charges for analysis are to range from 2s. 6d. to 10s.; and as Ireland is a great butter-producing country he will find his place no sinecure,—that is if he follows strictly the examination given by Dr. Brown.—I am, &c.,

J. CARTER BELL.

The Manchester Laboratory,
18, Exchange Street, July 21, 1873.

ON BUTTER.

To the Editor of the Chemical News.

SIR,—A little relaxation on Saturday last enabled me to become acquainted with the abstract of Dr. Campbell Brown's paper on the "Analysis of Butter" (CHEMICAL NEWS, vol. xxviii., p. 1), and the correspondence it has occasioned.

I have heard a good deal from the Doctor already about his method of analysing butter, in relation to a local inquiry. The published abstract is much more consecutive in details than the Doctor's replies to questions in the witness box. From the latter it would be inferred that he considers stearin and palmitin to exist in butter in a state analogous, if not identical, with that of *carbon* in sugar or paraffin; also that butter is physically constituted of an aggregation of globules in a manner similar to that of starch, German yeast, and such like bodies. This statement is repeated in the abstract of Dr. Brown's paper, section 3. It is such a novel assertion on the part of a scientific man, that I do not wonder Mr. Wanklyn's patience was a little ruffled by the study of it.

Respect for real or reputed scientific attainments, such as those accorded to Dr. Brown, determines me to give the statement that commercial butter, fresh or salt, is mainly composed of globular matter some consideration. I might, indeed, affirm a direct negative, as I did elsewhere, and so save time and space; but it may be well to add my reasons for the benefit of some readers who possibly may not be conversant with the subject.

Firstly, then, the matter of butter as it exists in fresh or new milk, presents the form of minute liquid globules. The microscope reveals that the globular form of the fat matter is due to the repulsive action of the aqueous menstruum and the liquid fat, and not to any enveloping tissue or coating which would conduce to the retention of the globules in their entity. When lactic acid is de-

veloped in the milk in sufficient quantity to overcome its natural alkaline condition and the milk is then churned, the diffused globules are made to adhere, and the result is a mass of solid butter of greater or less hardness, according to certain physiological conditions of the animal and its food. Now as the fat globules as observed in milk are devoid of cell walls, or envelopes, other than the aqueous medium in which they are diffused, it will be readily understood that when any number of them is made to adhere by the mechanical action of churning, the globular form presented in the milk will disappear, and other considerations being for the moment set aside, the resulting butter will present a homogeneous non-globular appearance under the microscope. Butter really does present this non-globular aspect when so examined.

Butter is not exceptional in this respect. All fatty substances, whether liquid or solid when educed as fats, from the bodies secreting them, animal or vegetable, are non-globular in their structure.

It is well to note the physical change impressed on the fat of milk by churning. Before this operation the globules in the milk are transparent and liquid; after, the fat is solid. Without going deeper into the consideration of the principle evoked in this change, I think it will be accepted as the result of the crystallisation of such constituents of the fat as are capable of assuming this state. Stearin and palmitin are such constituents. The crystals of the latter constituents are, however, so small in freshly churned butter as not to be defined by a 1-inch power; but let the butter when churned be washed with tepid water of 75° to 80° F., or let it be exposed after washing to a summer heat and then cooled, the crystals then become so large as to be readily discerned even by lower powers than a 1-inch objective. This fact is singularly confirmed in Dr. Brown's paper; and also the assertion that stearin and palmitin are not present as such in butter, as forcibly controverted. He states correctly that butter becomes opaque under 74° F.; above this heat a transparent fluid. Here the opacity is due to the separation of crystalline matter, and that matter stearin and palmitin, in varying proportions. If these constituents of butter existed in it as carbon exists in sugar or paraffin it would not be conceivable how the separation could so easily be effected. Dr. Brown, however, recently determined that certain butters submitted to him were adulterated, because he found crystallised matter in them; and corroborated his conclusion by the assertion that stearin, palmitin, and olein were not proximate components of butter. I use these names as synonyms of Dr. Brown's *glycerides*, and I dare say Mr. Wanklyn so comprehends them.

Regarding the estimation of water in butter, which varies from 8 to 20 per cent, a temperature of 212° in either water or air bath as prescribed by Dr. Brown, is inadequate. An approximate result may be obtained if the heating process were continued for a greatly disproportionate period, say a week, but not in the time devoted by analysts to such work.

Looking at Dr. Brown's paper as the exponent of his course of procedure, I may ask whether it is possible for him to execute the operations stated therein for the sum of 7s. 6d. and 5s. of current coin? for these it appears are the highest fees which he can charge in his official capacity.

Chemists appointed to carry out the provisions of the Adulteration Act, are introduced into a wide field of chemical study,—one which demands enlarged knowledge and experience to explore it, but from which much practical and valuable information can be obtained. Crude inconsiderate processes in the execution of the work will not add much lustre to the scientific standing of the analysts; and it may be well to show at the outset that conclusions founded on such crude or unreliable operations will not be accepted from them.—I am, &c.,

MARTIN MURPHY, F.C.S.

College of Chemistry, Liverpool,
July 22, 1873.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgement. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Zentralblatt."

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, June 30, 1873.

Reflections on a Memoir of La Grange, entitled "Essay on the Problem of Three Bodies."—M. Serret.

Extract from Memoir on the Analytical Theory of the Satellites of Jupiter.—M. Souillat.

Researches on the Reflection of Solar Heat at the Surface of Lake Leman.—M. Dufour.—The author experimented at five stations between Lausanne and Vevey, using three blackened bulbs containing thermometers. The first, suitably screened, gave the temperature of the air; the second, screened against direct solar radiation, received reflected heat; the third, unscreened, received both direct and reflected heat. The greatest proportion of reflected heat was 0.68 of the incident heat, and this was obtained with solar heights of $4^{\circ} 38'$ and $3^{\circ} 34'$. About 7° , the proportion was 0.4 or 0.5; about 16° , it was 0.2 or 0.3; while, if the sun was higher than 30° , the reflection was hardly appreciable. The author, however, failed to establish a law between the proportion of reflected heat and height of the sun. At stations some distance from the lake the proportion of heat reflected did not seem to increase with greater nearness of the sun to the horizon; the absorption by air probably compensating the increase which would otherwise appear. Most heat is reflected when the lake is calm. While a greater proportion of heat is reflected as the sun nears the horizon, the intensity of the direct ray diminishes, so that we come to a maximum of actual quantity of heat reflected. This maximum varies with the state of the surface and the diathermancy of the air. The total heat reflected, from the time at which reflection became sensible till sunset, was, at one station, in September, about equal to the heat radiated directly by the sun during the last three quarters of an hour before setting; at another station, in October, equal to that radiated directly in the last half-hour, &c. (various such comparisons were made). It was also approximately ascertained what absolute quantity was reflected by the lake in a square metre of a surface normal to the ray; this was, at four several stations, 104, 84, 112, and 134 calories respectively, in September and October. The foregoing results doubtless apply also to the sea, and have an important bearing on climate, vegetation, &c.

New Observations Proving the Presence of Magnesium in the Entire Border of the Sun.—M. Tacchini.—These observations were made on the 21st to the 23rd of May last. The author states it is clearly proved that there is greater activity in the northern hemisphere of the sun than in the southern, and that the general presence of magnesium corresponds to a minimum in the number of protuberances.

NOTE on Magnetism.—M. Gauguain.—The author indicates the mode in which he obtains the curves of demagnetisation, where an armature of soft iron is applied to the polar faces of a horse-shoe magnet, and withdrawn. It depends on the currents of induction produced in a wire. He thinks the idea of a condensation of magnetism near the surface of contact an erroneous one; for, when the armature is applied as stated, the magnetisation caused by currents of induction increases throughout the

extent of the horse-shoe, to the heel, or middle of the curve. Some other observations, with armatures of various shape and size, confirmed this. Again, when a soft iron bar is applied perpendicularly to the (length) surface of a horse-shoe magnet, the magnetic intensity appears to diminish about the bar, and it is commonly said that the magnetism, attracted by the soft iron, is condensed at the surface of contact. The author questions this; for, if, before applying the bar, the curve of demagnetisation of the branches of the horse-shoe be determined, and then the changes this curve undergoes after application, it is found that the curve is divided in two; the part between the bar and the extremity of the branch falls, and that between the bar and the middle of the curve rises, *i.e.*, the magnetisation diminishes on one side and increases on the other. How, then, will the condensation of magnetism explain the increase in the one region? It is easy to understand, on the other hand, how the opposite modifications of the curve of demagnetisation result in a diminution of magnetic intensity; which intensity depends on the inclination of this curve, and this diminishes, at the same time, for both parts of the curve. The author further compares his method of determining the intensities at different points of a magnetised bar with the method of oscillations adopted by Coulomb. The curves agree, except near the extremity of the bar, where, therefore, a simple relation M. Gauguain had established between the magnetic intensity and that of the solenoidal current no longer exists.

Cooling and Freezing of Alcoholic Liquids and Wines.—M. Melsen.

Calculation of the Moments of Inertia of Molecules. M. Hinrichs.

Note on the State of Sericulture in 1873.—M. Guerin-Meneville.

Comparison of the Indices of Refraction in Certain Isomeric Compound Ethers.—J. Pierre and E. Puchot.—The authors conclude that the numerical magnitude of the Index of Refraction, at least in the compound ethers, depends more on the chemical equivalent of the body than on its specific gravity.

Decomposition of Metallic Carbonates by Heat.—M. L. Joulin.—The carbonate of manganese was appreciably decomposed at 70°. Up to 200° this decomposition presents the characters of the phenomenon which Deville has named *dissociation*, *i.e.*, at a given temperature the tension of the carbonic acid, after a longer or shorter time, attains a value which remains constant, and that during the time of cooling the tension gradually returns to its primitive value, in consequence of the recombination of the carbonic acid and of the protoxide of manganese. From 250° to 300° the elastic force of the carbonic acid constantly increases up to two atmospheres. The body, which up to 200° had remained whitish, grows brown, the protoxide of manganese decomposing part of the carbonic acid, in order to convert itself into sesquioxide. Prolonged heating seems to render the carbonates more stable.

Production of Glycerin from Propylen.—C. Friedel and R. D. Silva.—The authors furnish confirmations of their former experiments and conclusions (*Comptes Rendus*, vol. lxxiii., p. 1379) to meet certain objections urged by Berthelot.

On a Glycerin of the Aromatic Series.—M. E. Grimaux.—The author endeavoured to obtain $C_9H_{12}O_3$; in other words, a molecule of glycerin in which an atom of hydrogen is replaced by the phenyl group, C_6H_5 .

Determination of Sugars by Barreswill's Method.—M. Loiseau.—Feltz has shown that when the cupro-tartaric liquid is alkaline, the soda reacts upon crystallisable sugar. The author had previously recommended various chemists to dilute with water the cupro-potassic liquids used for determining the small quantities of non-crystalline sugar which occur in the produce of the Paris

refineries. The author has since proved the existence of another source of error which soda may cause in the determination of glucose by Barreswill's method. This is due to the fact that soda promotes the restoration of a blue colour in the cupro-potassic liquid which has been decolourised under the influence of a sufficient quantity of non-crystalline sugar. Thus an excess of soda gives results below the truth. The test-liquid employed was prepared according to the formula of Fehling. It is needful to ascertain what proportion of soda should be present in the test-solution. This proportion can neither be increased nor lessened at random, since, if an excess of soda favours the re-colouration of the liquors, a too feeble alkalinity protrudes too much the decolouration of the liquid. It appears that Barreswill's method employed for the determination of glucose may yield different results, according to the manner in which it is used. The alkalinity of the liquid should be such that a litre may be neutralised by 240 c.c. of decinormal sulphuric acid. With this precaution the method gives results accurate enough for all commercial purposes. It may even be applied to the determination of raw sugars, and may furnish results as accurate as those given by polarimetric assays. On a future occasion the author will give what he considers the best formula for the test-solution, and explain why it should be protected from the carbonic acid of the atmosphere.

Erythrophenic Acid, a New Reaction of Phenol and Anilin.—E. Jacquemin.—We have given a summary of this paper elsewhere.

On Crystalline Protiodide of Mercury.—P. Yvon.—This compound is best obtained by heating mercury and iodine in equivalent proportions, in sealed flasks, upon the sand-bath. The temperature must not be allowed to exceed 250°. The upper portion of the flask will be found lined with crystals of a fine red, which become yellow on cooling. On re-heating, the red colour begins to return at 70°, and at 220° a splendid garnet shade is attained. This is exactly the inverse of the phenomena presented, under similar circumstances, by the biniodide. The crystals of protiodide melt at 290° to a black liquid, which boils at 310°. If more rapidly heated it is decomposed, yielding mercury and a light yellow sublimate, which is not, as might be expected, a compound richer in iodine, but an oxy-iodide which may be represented by the formula $Hg_2O_6I_2 = 6HgO, 7HgI$. This oxy-iodide is at first bright yellow and crystalline, but, especially if exposed to the light, it soon becomes first orange and then brick red, and falls to a powder.

Bulletin de la Société Chimique de Paris, tome xx., No. 2, July 20, 1873.

Determination of Ferric Oxide by Means of Hyposulphite of Soda.—J. M. Crafts.—The most convenient solvent for ferric oxide in iron ores is commonly concentrated hydrochloric acid, but such solutions are not well adapted for titration with permanganate of potash. They are, however, perfectly adapted for volumetric determination with hyposulphite of soda. This method, performed as has been hitherto recommended, is not as exact as could be desired. The author has endeavoured to eliminate the causes of error in this procedure, which is recommended by its rapidity of execution and by the stability and easy preparation of the reagents employed. The only cause of error lies in the decomposing action which the free acid of the ferric solution exerts upon the hyposulphite of soda, and care must be taken to diminish this excess of acid to the point where its disturbing action becomes inappreciable. The following procedure renders it possible to obtain results as exact as can be expected from a volumetric method. The following solutions are needed:—*Hyposulphite of Soda*.—The commercial salt, purified, should be well dried at common temperatures. It is exposed for several days in

thin layers between folds of blotting-paper, and is pulverised afresh every day to expose to the air fresh surfaces. It is only after the lapse of several days that a product is obtained sufficiently dry and well powdered. The salt, thus prepared, no longer loses weight in dry air, and after its value has been determined, a normal solution may always be obtained by dissolving in water the weight indicated by experiment. If the salt is pure, the amount necessary to dissolve in water to obtain a viginti-normal solution is 12.4 grms. Such a solution keeps its value for a month, within 0.2 or 0.3 per cent. The solution of perchloride of iron which serves as standard for these experiments is made by dissolving pure iron, whose percentage of carbon is known, in strong hydrochloric acid. A few drops of nitric acid are added; the mixture is boiled for a few minutes, and then evaporated, till the crust of ferric chloride which forms begins to re-dissolve with difficulty in the acid solution. During the ten minutes which the latter part of the evaporation requires, it is necessary to watch attentively, so as not to pass the proper point. To make a viginti-normal solution of iron, it is necessary to dissolve in a litre of water 2.8068 grms. of fine iron wire, containing 99.65 per cent. of metallic iron. It is of importance that solutions more concentrated than viginti-normal should not be used. The analysis may be made by adding the hyposulphite in known excess, and titrating back with iodine to ascertain the surplus of hyposulphite. As nearly as possible, the same excess of hyposulphite should be used on each occasion. The reduction is completed in five or six minutes, and its termination is ascertained by adding a little sulphocyanide of potassium, which should not give a red colouration. The well-known reaction between iodine and starch, which indicates when a sufficiency of iodine has been added, is not appreciably diminished in sensibility by the volume of the liquid. In practice, an iron ore is boiled in hydrochloric acid in order completely to dissolve the ferric oxide, and the solution is evaporated down to the point indicated above. If the protoxide in an ore is also to be determined, the evaporation must be preceded by oxidation. It is convenient to take for each analysis 1.4 gr. dissolved in half-a-litre. A preliminary titration serves to determine approximately the quantity of hyposulphite equivalent to 100 c.c. of the ferric solution, and in the final operation 20 per cent more hyposulphite is taken. Water which is added during the analysis must be deprived of atmospheric oxygen by boiling. Ferric chloride reduced to the ferrous state during an analysis of the procedure indicated may be exposed to the air for twenty-four hours without becoming sensibly oxidised.

Heat Liberated in the Reaction between Water, Ammonia, and the Alkaline Earths, Lime, Baryta, and Strontia; Constitution of Alkaline Solutions.—M. Berthelot.—A lengthy thermo-chemical paper.

On Certain Ammoniacal Salts of Silver.—M. O. Widman.—The salts in question have been obtained by dissolving the salts of silver in an excess of ammonia, and crystallising over a mixture of quick-lime and sal-ammoniac. The original silver salts were obtained by precipitating nitrate of silver with alkaline tungstates, molybdates, and arseniates.

On Certain Compounds of Zirconium.—S. R. Pajkull.—The compounds examined are the chloride, phospho-chloride, tetrachloride, sulphide, oxychloride, hydrate, sulphate, arseniate, and orthophosphate.

Action of Chloride of Benzyl upon Naphthylamin.—Ch. Frété and D. Tommasi.

Erythrophenic Acid, a New Reaction of Phenol and Aniline.—E. Jacquemin.—When phenol is treated with chlorine-water, no reaction is observed, and ammonia added to the mixture subsequently develops no colouration. It is known that aniline, on the contrary,

suspended in water, with the addition of a solution of chlorine, takes a rose colour, which rapidly becomes purple, violet, and, lastly, brownish red, and that ammonia added at this last juncture increases the brownness. It is no longer the same when a mixture of a drop of phenol and a drop of aniline is submitted to the action of solution of chlorine. A permanent rose-red is obtained, which may be turned to a blue either by ammonia or by the alkalis or alkaline carbonates. Acids restore the original redness. The author concludes that there exists a phenate of phenylamin; that the new body produced in the above reaction is a red acid, forming blue salts; the erythrophenate of soda may be produced by causing hypochlorite of soda to act upon the mixture of phenol and aniline. The blue thus formed is remarkable for its purity and extraordinary tinctorial power. If two drops of the mixture of phenol and aniline be added to 2 litres of water, and then treated with hypochlorite, the blue in an hour or two becomes so intense that it could be recognised even in 4 litres of water. This reaction may be useful in toxicological researches either for aniline or phenol. The purity and permanence of the blue might render it fit for the uses of the dyer, but it will not bear steaming. The extreme facility with which it is reddened by the feeblest acids is likewise an objection. In this respect it far exceeds litmus.

Transformation of Succinic Acid into Maleic Acid.—E. Bourquin.

Ethylacetylen Formed Synthetically, and on its Identity with Crotonylen.—L. Prunier.—The identity of those two substances has been established by a comparison of their tetrabromides.

New Method of Producing Chlorine.—F. de Lalande and M. Prud'homme.—Lamy, in examining the action of a mixture of hydrochloric acid and of air upon silicates or mixtures of silica and chlorides, which the authors had previously studied, seems to ascribe the evolution to the presence of oxide of iron in the substances brought in contact. It must be observed that the reaction may be thus expressed: oxygen displaces chlorine from chlorides at a red heat, and in presence of an acid capable of uniting with the base thus formed. A mixture of hydrochloric acid and of air may thus give rise to a continuous evolution of chlorine. The authors have experimented in glazed earthen tubes upon to grms. of fused chloride of sodium and to grms. of fused boracic acid placed either separately or together in a porcelain boat, and have found:—That chloride of sodium and boracic acid taken singly give at redness, in a current of dry air, mere traces of chlorine. In the same conditions a mixture of the two enabled us to collect 15 per cent of the chlorine present in the chloride of sodium. The displacement of chlorine by oxygen has been obtained in presence of the silicic, boracic, phosphoric, and stannic acids, and of alumina. The influence of the oxide of iron or other impurities is insignificant.

Composition of Bone Phosphate.—C. Aebv (*Journal f. Praktische Chemie*, vol. vi., p. 169, 1872).—For each equivalent of tricalcic phosphate the author finds half an equivalent of crystallised water; one-third of basic water, not expelled below 450°; one-third equivalent of lime in excess; and one-sixth equivalent of carbonic acid. The composition of bone ash is therefore highly complex.

Chemical and Crystallographic Notes on Certain Salts of Glucinum and the Cerite Metals.—C. Marnag (*Archives des Sciences de la Bibliothèque Universelle*, March, 1873).—The author examines the fluoride of glucinum and potassium; fluoride of glucinum and sodium; fluoride of glucinum and ammonium; sulphate of cerium; nitrate of lanthanum; nitrate of didymium; nitrate of cerium; ammoniac-nitrate of lanthanum; ammoniac-nitrate of didymium, and the chloro-platinates of the group. The author concludes the atomic weight of lanthanum to be 92.5.

Analysis of a Fossil Human Bone.—M. Terrier.—In one portion the carbonate of lime was 64.33 per cent, whilst the phosphate amounted merely to 17.12.

Influence of the Different Colours of the Spectrum upon the Decomposition of Carbonic Acid of Plants.—W. Pfeffer (*Pog. Ann.*, vol. cxlviii., p. 86, 1873, No. 1).—Taking the amount decomposed under the yellow ray at 100, the following scale was obtained:—

Red..	25.4
Orange	63.0
Yellow	100.0
Green	37.2
Blue	22.1
Indigo	13.5
Violet	7.1

Reimann's Färber Zeitung, No. 26, 1873.

Dialysed Iron.—For mordanting silk, &c., iron can be applied in the state of dialysed oxide. To prepare this compound, a solution of iron oxide in hydrochloric acid is introduced into the dialyser. After some time, the hydrochloric acid will be found to have escaped into the surrounding water, whilst the oxide of iron remains in the dialyser in a soluble condition, free from any hurtful amount of acid. This solution is found remarkably well adapted for dyeing heavy blacks upon silks, which it mordants in perfection without "tendering" the fibre. It would seem as if every case of mordanting was a dialytic phenomenon, the fibre being in effect a conglomerate of membranes. The degree to which the iron solution is to be deprived of its acid is a matter to be determined by experience in such class of cases.

Practical Receipts.—The editor gives formulae for dyeing old batist articles a red-brown; for dyeing cotton-warp a rose-colour, and for producing yellow lists on woollen piece-goods dyed with Brazil, log, sanders, and calliatur-woods; for a discharge with fuming nitric acid; for dyeing scarlet on flannel or woollen-yarn, in which there appears nothing novel; and for dyeing cotton-wool a black.

Anthracen Blue, an Alleged New Colour.—According to its reactions this is an ordinary aniline blue. Anthracen can produce tinctorial acids, such as alizarin, but not substantive basic colours.

New Iron Mordant.—Dissolve 200 grms. chromate of potash, 200 grms. oxalic acid, and 6 kilos. green vitriol, in 6 litres of water.

Revue Scientifique de la France et de l'Etranger,
July 19, 1873.

This number contains no chemical matter.

Archives Néerlandaises, Tome vii., Livrais 4, 5.

On Nonylic Acid.—P. N. Franchimont and Th. Zincke.

On Normal Heptylic Acid.—P. N. Franchimont.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in and connected with the manufacture of electrotypes. James Noad, engineer, Hackney Wick, Middlesex. December 18, 1872. No. 3599. A new material is used for forming the moulds, consisting of lead melted and mixed with roll-sulphur, ground fine, then mixed with gutta-percha or its equivalent. To copy type, this material is melted, brushed over with black-lead, then softened, and pressed on the type; afterwards it is put into a lead bath, and worked by a battery, then washed, and put in a copper bath, and lacked. To surface, the mould is put into a sulphate of copper bath containing 7 per cent free acid, the bath is worked with a large anode, and rubbed during deposition,

Improvements in the estimation of metals. Joseph Norman Lockyer, F.R.S., Finchley Road, Middlesex. December 18, 1872.—No. 3566. My invention consists in the application of the spectroscopic to the estimation of metals.

Improvements in treating human excreta, and in apparatus for working the excreta and converting the same into a dry and highly concentrated manure. William White Fereday, civil engineer, 5, Falmouth Road, Dover Road, Surrey. December 21, 1872.—No. 3582. This Provisional Specification describes a system of collecting night-soil, and converting it into manure in such manner that no effluvia is emitted or ammonia lost.

Improvements in the manufacture of asphalt for paving and covering roads and ways, and in the apparatus employed therein. Alexander Prince, 4, Trafalgar Square, Charing Cross. (A communication from Peter Barthel, Ferdinand Capitaine, and Philip Holmman, all of Frankfort-on-the-Maine). December 21, 1872.—No. 3586. The novelty of the invention consists in dissolving natural asphalt in sulphure of carbon or in benzene, by the application of heat, the solution of which, when passed through a sieve, is placed in a bottle heated by steam and a furnace, in order that the sulphure of carbon or benzene held in solution may be evaporated, after which the asphalt is mixed with granular calcareous spar or marble, preparatory to its being used for the purpose desired.

An improved stopper for bottles. Alphonse Krieger and Augustin Cauderlier, Boro', Surrey. December 21, 1872.—No. 3587. The stopper consists of a short tube of india-rubber, one end being closed and of bulbous form, to press against the inside of the neck of the bottle and make a tight closure. A head is provided to prevent the stopper being pushed too far into the bottle, and for handling the same.

An improvement in the process of unhairing and preparing skins or hides to be employed for making or dressing into leather of any kind. Joshua Senior, foreman skinner, New Road, West End, Middlesex. December 23, 1872.—No. 3589. Hitherto lime has been used for this purpose, but in carrying out my invention I make use of soda ash or any other alkaline solution in combination with lime. To 16 gallons of boiling water I add about 2 lbs. of soda ash, which must be stirred till the alkali is completely dissolved; then, immediately afterwards, about 1 cwt. of fresh quick-lime must be thrown in gradually. It will then begin to boil fiercely, so that the pit-tank or any other suitable vessel should be sufficiently large to prevent it from overflowing. As the dose boiling, the solution is not all absorbed, a little more fresh lime may be added; when the mixture is quite cold it is ready for use, and should be of the consistency of soft clay. To each pit capable of containing or working fifty or sixty doses of sheep skins, I add 1 cwt. 2 qrs. to about 2 cwt. of the mixture, with a sufficient quantity of water, may be put in when making new.

Improvements in closets and apparatus for collecting and disinfecting faecal matters and converting the same into manure or human guano. Leon Antiger, civil engineer, New Crown Street, Middlesex. December 24, 1872.—No. 3593. The first part of this invention relates to improvements in the arrangement and construction of water-closets for the purpose of preventing the water (used for washing the pan) from mixing with the urine and faecal or solid matters. The second part of this invention relates to improved apparatus for receiving, treating, and filtering the urine and faecal matters as they are discharging from the water-closet or other source. Thirdly, in the application of a new chemical solution for the direct chemical treatment of urine in order to extract the salts (ammoniacal) which may be mixed with the solid matters, in order to increase the agricultural value of the manures thus obtained. Fourthly, in improved arrangement and chemical disposition of apparatus for the purpose of applying this improved system to urinals in order to treat the urine chemically. Fifthly, in improved means of preserving the manure when dried and pulverized, together with improved chemical compounds for raising the fertilizing principles which the organic matters contain, in order to avoid their destruction, which generally follows by decomposition (caused by fermentation).

NOTES AND QUERIES.

Creme-Yellow.—(Reply to "Colour.")—The yellow colour you refer to is tungstic acid made from the tonate of soda.—A. KRIPPENHEIM and Co., 7, Side, Newcastle-upon-Tyne.

TO CORRESPONDENTS.

* Vol. XXVII. of the CHEMICAL NEWS, containing a copious index, is now ready, price 11s. 4d., by post, 12s., handsomely bound in cloth, gold lettered. The cases for binding may be obtained at our office, price 1s. 6d. Subscribers may have their copies bound for 2s. 6d. if sent to our office, or, if accompanied by a cloth case, for 2s. Subscribers wishing to complete their sets of volumes are requested to apply to the publisher, who will give them information respecting scarce numbers and volumes. Vol. XXVII. commenced on July 4th, and will be complete by September 15th. PRICING LIST, price 1s. 6d. each, post free, may also be obtained at the Office.

G. A.—We shall be happy to insert your letter if you conform to our rules and send us your address.

BOOKS RECEIVED.

The Trustees' Guide (Cracroft's Investment Tracts). London, Edward Stanford.

SUPPLEMENT TO THE CHEMICAL NEWS.

VOL. XXVII. No. 713.

INVESTIGATION OF THE FLUORESCENT AND ABSORPTION SPECTRA OF THE URANIUM SALTS.*

By HENRY MORTON, Ph.D.,
and H. CARRINGTON BOLTON, Ph.D.

AMONG bodies possessing a property which he named "internal dispersion," Sir David Brewster, in 1848, mentioned a glass of a greenish yellow colour. In his admirable treatise "On Fluorescence," published in the *Phil. Trans.* for 1852, Stokes describes the examination which he made of the light emitted from the glass, which he found to yield a discontinuous spectrum, and relates how, finding that the colouring material of this glass was the oxide of uranium, he proceeded to study other compounds of the same base.

The following is a list of the bodies thus examined:—

1. Nitrate of uranium, crystals and solution.
2. Yellow uranite (lime uranite).
3. Green uranite, or chalcocite (copper uranite).
4. Pitch blende.
5. Hydrate of peroxide of uranium, $U_2O_3 \cdot 2H_2O$.
6. Acetate " "
7. Oxalate " "
8. Phosphate " "
9. Uranate of potassa.
10. " lime.
11. Solutions by means of alkaline carbonates.

This paper of Stokes was the first thorough discussion of the subject, and at once established the true character of fluorescent actions, which, though before observed in a few instances, were in no wise understood. The investigation is, indeed, a masterpiece in its originality, ingenuity, and thoroughness; but in science no work can ever be exhaustive, and thus even such a research as this leaves ground yet to be explored. The spectroscopic, as an instrument of precision, had not, in fact, at this time been thought of, while the general character of the spectra formed by the fluorescent light emitted by many of the above list of substances was discussed, as also the bands of absorption shown by some of them with transmitted light; no attempt was made to measure the exact location of bands, and to record accurately their relative positions in different compounds, and other matters of detail requiring precise measurements. It is, however, wonderful, notwithstanding this, how far progress was pushed even with the less perfect appliances then at command; and we shall have frequent occasion to refer to Professor Stokes's prior indications of actions which more refined instrumental appliances have enabled us fully to develop.

In 1859 Becquerel published in the *Ann. de Chim. et de Phys.*, 3rd series, vol. lvii., p. 101,† an account of observations made with his phosphoscope, and other methods involving the use of a spectroscopic, upon many bodies, including the following uranium salts:—

1. Nitrate of uranium.
2. Uranium glass, i.e., canary glass.
3. Double fluoride of uranium and potassium.
4. Perchloride of uranium, i.e., oxychloride of uranium.
5. Uranite.
6. Double sulphate of uranium and potassium.

Two drawings are given to indicate the position of the bright bands with reference to the Fraunhofer lines, the first representing the spectra of canary glass and uranic

nitrate, the other those of potassio-uranic oxyfluoride, uranic chloride, and the mineral uranite.

The existence of absorption-bands in crystals of uranic nitrate is also noticed, but no measurements or exact description is given. Indeed this work, which deals chiefly with phosphorescence, devotes but a small space to the subject we are now considering.

Various other brief discussions, such as that of Werther in the *Zeits. für Prakt. Chem.*, vol. lxx., p. 349,* in which the simple fact of fluorescence and the general colour of the emitted light is noticed in some salts of uranium and other bodies, appeared subsequently, but no other work of importance or extent was undertaken for some time after that of Stokes and Becquerel in reference to the uranium salts in their fluorescent relations.

This was about the condition of the subject when, in the spring of 1872, we undertook the accurate measurement and plotting of the fluorescent spectra of the uranium salts, preparing all the salts used ourselves so as to be confident of their purity.

A large number (over thirty) had been so studied, the results classified and discussed, and a memoir partly written, when, in the *Comptes Rendus*, August 5, 1872, we found the abstract, published by Becquerel, of a research covering very much the same ground. In the December number of the *Ann. de Chim. et de Phys.* for the same year appeared the entire memoir, in which were given the observations and measurements made upon eighteen salts.

Many of his conclusions were, however, different from those at which we had arrived, and we therefore determined to withhold our publication until these points of variance could be thoroughly re-examined. Such examination has confirmed our original results, and we therefore now publish our work as an independent research, which, of course, lays no claim to any of the results already obtained by Becquerel, but which will be of value as a combination of these, and will add to the knowledge of the subject in many directions, in which what we have done has been nowhere anticipated.

We should also state that Hagenbach, in his admirable series of papers on fluorescence, has given measurements of the spectra of canary-glass and uranic nitrate, *Pogg. Ann.*, vol. cxlvi., p. 393.

Methods Employed.

Our methods of examination do not differ from those employed by Stokes and Becquerel except in small details by which the labour of observation was facilitated, and by the means at our disposal for securing accuracy in the measurements. They have already been described by one of us, in connection with a similar investigation in which they were employed,‡ but to avoid trouble of reference, we will here briefly re-state them.

The general method pursued was as follows:—

Sunlight being reflected horizontally into a darkened room by a porte-lumière was concentrated by a lens, and filtered of all rays below Fraunhofer's line F by a tank containing a strong solution of ammonio-cupric sulphate placed in front. Two tanks containing liquids of different concentration interchangeably used.

In the front of the lens was placed a little circular table carrying on its edge eight niches capable of supporting test-tubes or specimen bottles, and rotating with a "click," so that each of these could be readily brought into an identical position. The blue light falling on the specimen placed in one of these niches, the dispersed light was observed by means of a spectroscopic. The instrument most used in this work was a Browning single-prism spectroscopic, though one (by the same maker) with two prisms, and also a chemical spectroscopic of Dérang, were also employed in special cases. A direct-vision hand

* See also *Phil. Mag.*, 1855, vol. x., p. 390.

† "The Fluorescent Relations of Certain Hydrocarbons found in Petroleum Distillates," by Henry Morton, *CHEMICAL NEWS*, vol. xxvi., p. 724.

* Communicated by Professor Morton.

† See also "La Lumière," vol. I., p. 378.

spectroscope was also found very useful for preliminary observations and for recognition of faint absorption-bands.

For the study of the absorption spectra, the various pieces of apparatus were re-arranged so as to observe transmitted light, the rotating stand being replaced by a block or table, on which the objects were successively placed.

To observe solid substances in this way, various devices were employed. If a crystal of the requisite dimensions could be obtained, it was cemented to a plate of glass or mica, and supported vertically by means of a flat cork, in which the edge of the plate was sunken. Powders, such as the uranic oxalate, phosphate, &c., were mixed with a little water, and allowed to dry in a thin film on plates of glass or mica. In other cases, as with the double uranic sulphates, the salt was placed on a slip of glass and moistened with a very little water. Another similar glass was then placed upon it, and pressed down with a gentle rotary or grinding motion, by which the substance was reduced to small fragments in close proximity, which formed a film whose thickness could be graduated with ease. Gummied labels pasted over the ends of the slips kept all in place.

Solutions were examined either in bottles of white glass of about 1 oz. capacity (being 1 inch in diameter), or in small specimen bottles made from glass tubes whose diameter was only about $\frac{1}{4}$ inch.

Other special arrangements, which were from time to time employed in particular cases, will be described in connection with the substances to whose examination they were adapted.

We hereto append a list of the substances which we have prepared, and whose spectra, both of fluorescence and absorption, we have carefully measured and mapped.

URANIUM COMPOUNDS OBSERVED.

<i>Acetates</i> —	Sodio-uranic oxyfluoride.
Uranic acetate bi-hydrate.	Uranous fluoride.
" (anhydrous).	Sodio-uranous fluoride.
Ammonio-uranic acetate.	Potassio- " "
Bario- " "	<i>Formiate</i> —
Calcio- " "	Uranic formiate.
Cadmio- " "	<i>Nitrate</i> —
Cobalto- " "	Uranic nitrate.
Plumbo- " "	<i>Oxalates</i> —
Lithio- " "	Uranic oxalate.
Magneso- " "	Potassio-uranic oxalate.
Manganio- " "	<i>Oxides</i> —
Nickelo- " "	Uranic oxide (anhydrous).
Potassio- " "	" (hydrated).
Silver- " "	Three-fourth oxide (uncryst.)
Sodio- " "	" (crys.)
Strontio- " "	<i>Phosphates</i> —
Thallio- " "	Mono-uranic phosphate.
Rubidio- " "	Di- " "
Zinco- " "	Hydrated di-uranic " "
<i>Arsenates</i> —	Uranic pyro. " "
Mono-uranic arseniate.	Ammonio-uranic " "
Di- " "	Calcio- " "
Sodio- " "	Cupro- " "
Cupro- " "	<i>Sulphates</i> —
<i>Borate</i> —	Uranic sulphate tri-hydrate.
Sodio-uranic borate.	Do. (mono-hydrated).
<i>Citrate</i> —	Ammonio-uranic sulphate
Ammonio-uranic carbonate.	bi-hydrate.
Potassio- " "	Do. (anhydrous).
Sodio- " "	Ammonio-di-uranic sul-
<i>Chlorides</i> —	phate (anhydrous).
Uranic chloride (acid).	Lithio-uranic sulphate.
" (neutral).	Magneso-di-uranic sul-
Ammonio-uranic chloride.	phate hepta-hydrate.
Potassio- " "	Magneso-uranic sulphate
<i>Fluorides</i> —	tetra-hydrate.
Uranic oxyfluoride.	Do. (anhydrous).
Ammonio-uranic oxyfluorid.	Potassio-uranic sulphate bi-
Bario- " "	hydrate.
Potassio- " "	Do. (anhydrous).

Rubidio-uranic sulphate bi-hydrate.

Do. (anhydrous).

Sodio-uranic sulphate penta-hydrate.

Do. mono-hydrate.

Do. (anhydrous).

Thallio-uranic sulphate tri-hydrate.

Do. (anhydrous).

Uranous sulphate.

Uranates—

Ammonium uranate.

Barium " "

Sodium " "

Plumbic " "

Potassium " "

Thallium " "

Tetraphylium " "

In Fig. 1. we have given drawings of some of the most characteristic spectra of fluorescence and absorption. In these drawings the refrangibility of the light is indicated on the scale with millimetre divisions introduced for this purpose by Bunsen. This scale was selected for the double reason, that it corresponds very nearly with the appearance of the spectrum as seen in the spectroscope employed, which is one largely in use and peculiarly well adapted to such observations as the present, and that it is largely used in all chemico-spectroscopic work, and would therefore be most familiar to those likely to take interest in this work, which has a decided chemical affiliation.

The relative intensities of various parts of the bands, and of the bands of each spectrum among themselves, is indicated by the depths of the white spaces, the distinction between the bright bands of fluorescence, and dark bands of absorption, being marked by making the first white and the other shaded. No attempt is made to indicate the relative brightness of different spectra.

This woodcut is to be regarded, however, rather as an illustration than as a map in which various positions are to be found with great precision. From the nature of the work, correction after proof is limited to very slight variations, and the full difficulty of accurate execution did not appear until the work was finished.

The spectra, as here shown, will be found correct in the character and arrangement of the bands in each, but small errors in the location of the maxima of bands must be expected, and, in fact, for all points where precision is required, it will be necessary to refer to the exact numerical expressions.

As will be seen further on, the behaviour of absorption-bands is a very useful assistance and guide to the study of certain changes in these salts, and we have therefore given some attention to these, although a variety of considerations indicate that no such connection exists between the band of absorption and fluorescence in these salts, as would be at first suggested by their general similarity of arrangement.

A single glance at the woodcut will exhibit the existence of very characteristic differences between the spectra of certain salts, and it will be evident that, in a number of cases, one body can be readily discriminated from another by this means. Indeed, in the course of this investigation, the fact of admixture in many of the commercial uranium salts was recognised in this way, without opening the bottles in which the materials in question were packed, and, in other cases, the progress and consummation of a change in composition, or in the formation of a compound, was watched and recognised with the greatest ease and precision.

In almost every case there is a tendency of the light to fade off in the bands towards one side more gradually than towards the other. In nearly all spectra this graduation is greatest towards the less refrangible end of the spectrum.

The character of any one band is, as a rule, a type of all the bands of a spectrum; but to this a remarkable exception is found in the double acetates of uranium generally, and especially in the sodium salt whose fluorescence is the brightest.

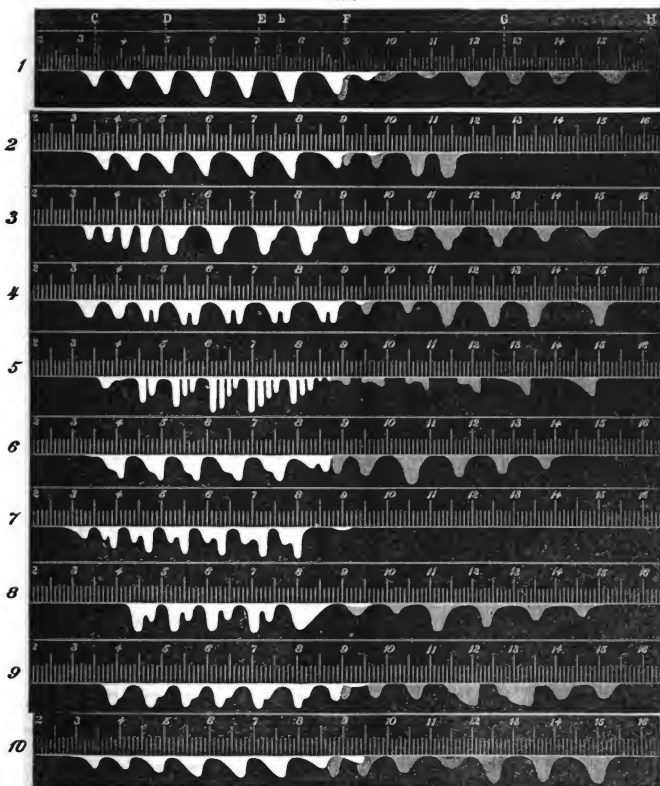
In the spectrum of this salt the first four bands at the lower end of the spectrum in the orange and red differ entirely in character and spacing from the rest, except the fifth, which seems to be in a transition state. This will be seen at once by a glance at spectrum 3 of the woodcut.

It is also true, as a rule, that double salts with the same acid have bands of a like character; but to this also there are decided exceptions, and it is by no means true that all salts with the same acid—as, for example, acetates and double acetates, as stated by Becquerel—have like bands. This chances to be true in the case of

the sulphate and normal double sulphates, but in the case of the acetate and double acetates, fluoride and double fluorides, chloride and double chlorides, as also among the numerous hydrates of the sulphates, it fails to maintain itself.

A glance at spectra 4 and 5 on Fig. 1 will show that

FIG. 1.



1. Uranic nitrate. 2. Uranic acetate. 3. Sodio-uranic acetate. 4. Uranic oxychloride (acid), mixed hydrates.
5. Potassio-uranic oxychloride. 6. Uranic oxyfluoride. 7. Bario-uranic oxyfluoride. 8. Uranic phosphate, mixed hydrates. 9. Calcio-uranic phosphate. 10. Ammonio-uranic sulphate.

nothing could well be more unlike than the spectra of uranic oxychloride and the potassium chloride.

The question naturally arises, how far the spectra of substances are constant, and in what way a change in spectrum if observed is to be interpreted.

To this we would reply that we have so far found that no substance has its spectrum changed by anything which does not affect its composition, excluding the effect of heat, which in all cases temporarily modifies fluorescent action, and the destruction of crystalline structure by fusion, which in some cases has a like effect permanently. We must also exclude certain cases in which, by peculiar treatment, a substance has been caused to give a continuous spectrum, in place of what may be considered its normal one.

We may, therefore, confidently assert in many cases whether (under certain treatment) a body has or has not suffered a change in composition, and, indeed, trace such a change step by step.

This part of the subject can be best elucidated by a narration of our experience in the first case in which this principle was applied.

Stokes had noticed certain effects in nitrate of uranium which had been fused and partly dehydrated, and after an

refrangible extremities of the scale. The following table will give some notion of these spectra:—

Fluorescent Spectra of Ammonio-Uranic Sulphates.

	I.	II.	III.	IV.	V.	VI.	VII.	VIII.
Normal salt	36.0	41.6	49.2	58.1	68.0	77.0	86.0	93.0
(hydrated) ..								
Dried salt (anhydrous)	33.4	40.0	48.0	56.3	65.7	75.2	86.0	92.8
Heated salt ..	36.0	42.4	51.2	60.3	70.0	79.8	89.2	96.8

As also Figure 2, in which 1 is the normal salt, 2 the mixture of this and the anhydrate obtained by partial drying, 3 the pure anhydrate, 4 the mixture of this and the new salt obtained by partial ignition, and 5 the pure ammonio-di-uranic sulphate.

The white fumes expelled in the process of heating were ammonium sulphate, and the resulting compound yielding the new spectrum, therefore, might have been formed in one of two ways; either all the ammonium sulphate had been driven out, or a portion only. It became necessary, therefore, to test the heated salt for ammonia, which was done by distilling a portion with hydrate of calcium, and receiving the distillate in Nessler's reagent. The abundant precipitate obtained established the presence of ammonia in such quantity as to render the delicacy of the test applied quite superfluous.

The question then arose, Is this salt a definite compound of uranic sulphate with ammonium sulphate? Analysis alone could reply.

The heated salt possessed a somewhat stronger greenish hue than the normal salt; it was completely soluble in water with the exception of a few dark coloured grains, probably consisting of U_3O_4 .

For analysis the salt was dissolved in water, and the sulphuric acid thrown down by barium chloride; after separating the excess of this reagent in the filtrate the uranic oxide was precipitated by ammonia, ignited and weighed as U_3O_4 in the usual manner:—

0.6444 grm. gave 0.5284 grm. $BaOSO_4 = 28.15$ per cent SO_3 , and 0.4194 grm. $U_3O_4 = 66.30$ per cent U_2O_5 . The formula, $2(U_2O_5SO_3) + NH_4HSO_4$, requires the following percentages:—

	Calculated.	Found.
$(U_2O_5)_2$	288	66.36
NH_4O	26	5.99
(SO_3)	120	28.15
	434	

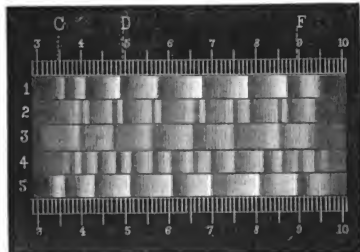
From this it is evident that one-half the ammonium sulphate in the normal salt is driven out by heating, leaving an anhydrous ammonio-di-uranic sulphate.

In his recent memoir Becquerel describes, under the name of a sub-ammonio sulphate of uranium, a salt obtained in the preparation of nitrate of uranium from impure materials, and states that it is the only uranium compound whose fluorescent light yields a continuous spectrum. The composition given by him (U_2O_5 , 4 parts, SO_3 2 parts, ammonia 1 part), unless regarded as a mere rude approximation, would agree better with a mixture of several salts than with any probable formula of an ammonio-uranic sulphate. This may, however, be a case of what may be called the abnormal continuous spectrum already alluded to.

We have found uranium compounds yielding continuous spectra, but the true sub-ammonio sulphate—or, rather, ammonio-di-uranic sulphate—does not appear to belong to that class.

(To be continued.)

FIG. 2.



attempt to reproduce his results, the ammonio-uranic sulphate was in turn treated in a like manner.

A little of the crystallised salt containing 2 atoms of water was placed in a short test-tube, and heated until part of its water had been expelled. On examination (after cooling, for while hot little fluorescence was manifested) its spectrum was found to be of a duplicate character, consisting of the bands belonging to the normal salt, and another set, each line of which was a little displaced downwards in the spectrum. On heating again and expelling more water, the intensity of the new spectrum was increased, and that of the old one diminished; and this continued until—when water ceased to come off—the new spectrum alone occupied the field. It was, therefore, concluded that this was the spectrum of the anhydrous salt.

On now pushing the heat further white fumes were expelled from the salt, and on examination—in addition to the spectrum just described—yet another new one was perceived, having its bands displaced upwards in a very marked manner. Further heating drove off more white fumes and strengthened this new spectrum, while it diminished the one proper to the anhydrous salt, until at last fumes were no longer expelled even at a temperature of about $650^\circ F.$, and the last spectrum in turn occupied the field alone. It was then seen to be like the spectrum of the normal salt in character, but with its bands displaced upwards in a degree increasing from the less to the more

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ON THE PRESENCE OF CYANOGEN IN BROMINE.

By T. L. PHIPSON, F.R.D., F.C.S., &c.

I HAVE lately discovered in bromine issued as pure for pharmaceutical use, a notable amount of cyanogen. It has been known for many years (and I have myself alluded to it in another place) that during the manufacture of iodine a certain quantity of that most beautiful, but dangerous, compound, iodide of cyanogen, sometimes finds its way into one of the glass condensers; and it would appear, from the experiments to which I now allude, that a similar compound with bromine may occur in this liquid element—a more serious case than the other, since it is dissolved and masked in the liquid.

The presence of cyanogen in bromine may be detected in the following manner:—Take an equal weight of iron filings (say 4 oz.) to that of the bromine, and add to the iron filings four or five times their weight of water; mix in the bromine very gradually, and stir all the time, filter rapidly while warm from the reaction, place the filtered liquid in a partially closed bottle, and in the course of some hours a deposit of ferricyanide of iron (Berlin blue) will have formed, and may be collected on a filter. In the course of two days (with the above quantity) the whole of the cyanogen is thus eliminated.

In the samples of bromine hitherto examined, I estimate there has been from 0.5 to 1 per cent of cyanogen in round numbers, and I am rather inclined to believe that this substance is often present in commercial bromine. If perfectly pure bromine be used, the same reaction would enable us to detect cyanogen in steel.

ON THE ESTIMATION OF MAGNESIUM AS PYROPHOSPHATE.

By WOLCOTT GIBBS, M.D.

ALL works on quantitative analysis recommend the precipitation of magnesium in the form of ammonio-magnesian phosphate, from cold solutions, by disodic phosphate. I find it more convenient, if not more accurate, to employ microcosmic salt as a precipitant, and to precipitate from concentrated and boiling solutions. After cooling ammonia is to be added, and the process then continued in the usual manner. The following analyses were made under my direction by Mr. C. E. Munroe to test the method. In the first series pure magnesian sulphate was precipitated at a boiling heat and in concentrated solutions by microcosmic salt, no ammoniac chloride being present.

1.	0.6430 gr.	gave 0.2914 gr.	$Mg_2P_2O_7 = 0.85$
2.	1.1523 "	" 0.5210 "	" = 0.79
3.	0.7064 "	" 0.3181 "	" = 0.78
4.	0.8081 "	" 0.3666 "	" = 0.80

The formula $SO_4Mg + 2OH_2$ requires 0.76 per cent. The mean of the four analyses is 0.84 per cent too high. In a second series the same process was employed, but ammoniac chloride was added to the magnesian solution before precipitation. In this manner:—

5.	0.5448 gr.	gave 0.2461 gr.	$Mg_2P_2O_7 = 0.76$
6.	0.6684 "	" 0.3026 "	" = 0.78
7.	0.7610 "	" 0.3442 "	" = 0.78
8.	0.6408 "	" 0.2906 "	" = 0.79

The mean of the four analyses gives 0.78 per cent, or 0.02 per cent too high,

Two analyses were then made by precipitating the boiling solution of disodic phosphate after adding ammoniac chloride. In this manner:—

9.	0.5407 gr.	gave 0.2536 gr.	$Mg_2P_2O_7 = 10.13$ per cent.
10.	0.8305 "	" 0.3881 "	" = 10.10 "

This method must therefore be wholly rejected, the mean error being +0.35 per cent.

The same process was then repeated, only the precipitated ammonio-magnesian phosphate at first obtained, after addition of ammonia water and perfect subsidence, was re-dissolved in dilute chlorhydric acid, and again precipitated by ammonia. In this manner:—

11.	0.5916 gr.	gave 0.2686 gr.	$Mg_2P_2O_7 = 9.79$ per cent.
12.	0.7371 "	" 0.3340 "	" = 9.79 "

The error is here only +0.03 per cent, but the method is longer in its application and less convenient than that given above with microcosmic salt. This last may, I find, be used with equal advantage in precipitating manganese from hot solutions. The precipitate is crystalline, and the process is more convenient than that which I formerly gave. A little ammonia should be added to the solution before filtering.

On the Estimation of Cobalt.—The extraordinary stability of the cobaltid-cyanide of potassium, $Co_2Cy_{11}K_6$, enables us to separate cobalt advantageously from many other metals by bringing it into this form. Wohler first proposed to precipitate the double cyanide by mercurous nitrate, and to weigh the cobalt finally as metal. I find it particularly advantageous to precipitate at a boiling heat, and then boil for a few minutes with mercuric oxide, so as to neutralise as completely as possible any traces of free nitric acid. By precipitating from hot solutions a granular, crystalline, mercurous salt is obtained, which is very readily washed. The following analyses were made to test the method. In (1) and (2) the precipitation was effected at a boiling heat, and the precipitate was simply washed with hot water containing a little mercurous nitrate. The cobalt was, after careful ignition with free access of air, finally reduced in hydrogen. The salt employed was pure crystallised $Co_2Cy_{11}K_6$.

(1).	0.5063 gr.	gave 0.0890 gr. cobalt = 17.57 per cent.
(2).	0.6785 "	" 0.1197 " = 17.64 "

The filtrate, after evaporation to dryness and ignition, gave with borax, before the blowpipe, an extremely faint reaction for cobalt. In analyses (3) and (4) the solution was boiled with HgO in small excess before filtration.

(3).	0.5332 gr.	gave 0.0947 gr. cobalt = 17.76 per cent.
(4).	0.6218 "	" 0.1101 " = 17.71 "

In (5) mercuric chloride was first added to the solution, and afterward sodic hydrate, until HgO remained undissolved on boiling.

(5).	0.5855 gr.	gave 0.1035 gr. cobalt = 17.68 per cent.
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The formula requires 17.76 per cent.

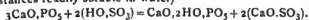
ON THE SO-CALLED "REDUCED" PHOSPHATE AND THE VALUATION OF OLD COMMERCIAL FERTILISERS.

By CHARLES U. SHEPARD, Jun., M.D.

In view of the great consumption of commercial fertilisers in the Southern Country, it may be deemed proper to devote a few pages of this journal to the consideration of certain questions involved in the valuation and use of superphosphates. Although the writer feels that this article leaves much undone, to the consideration of which points he intends returning on the completion of other experiments, still he is led to publish the results of some investigations, carried on in his laboratory, in answer to the wishes of certain friends of agriculture and agricultural chemistry.

The basis of the superphosphates employed in this region is, pre-eminently, the South Carolina phosphatic rock, an impure phosphate of lime. It consists of about 55 per cent phosphate of lime, 5 to 10 per cent carbonates of lime and the protoxide of iron, a few per cent oxides of iron, and traces of magnesia and alumina, partially combined with phosphoric acid; the remainder being unimportant for our present study. The phosphate of lime is, in all probability, entirely of the character of the so-called bone phosphate, or basic phosphate of lime, i.e., the chemical compound of 1 atom of phosphoric acid and 3 of lime. This form of phosphoric acid, the one important for vegetable and animal life, requires 3 atoms of base, whether they be metallic oxides (as lime) or simply atoms of water. The basic phosphate of lime is, practically considered, insoluble in water (especially in its mineral state), as is also the neutral phosphate of lime, a compound of 1 atom of phosphoric acid, 2 of lime, and 1 of water. On the other hand, the acid phosphate of lime, a compound of 1 atom of phosphoric acid, 1 of lime, and 2 of water, is highly soluble in water. The "free" phosphoric acid, also quite soluble, is an atom of this acid with 3 atoms of water joined chemically to it.

Dr. Piccard has shown (in the *Swiss Polytechnical Journal*)—(1). That a complete solution of 1 equivalent of basic phosphate of lime is produced by the addition of not less than 2 equivalents of hydrated sulphuric acid, (i.e., 2 equivalents of hydrated sulphuric acid act on 1 equivalent of basic phosphate of lime to produce 2 equivalents of gypsum and 1 of acid phosphate of lime, substances readily soluble in water)—



The excess of water ordinarily present furnishes the requisite quantity of water to produce 2 equivalents of hydrated sulphate of lime, $\text{CaO}, \text{SO}_3 + 2\text{HO}$.

(2). By the action of more than 1 and less than 2 equivalents of hydrated sulphuric acid upon 1 of basic phosphate of lime, either of the following cases may occur:—

(a). Where only 1 equivalent of sulphuric acid is taken, and subsequent changes in the mixture are arrested by an early separation of the soluble and insoluble portions; in this case one-half of the basic phosphate of lime is converted into acid phosphate of lime and gypsum. (b) Where the mixture is allowed to stand for a long time, and opportunity is thus afforded for the completion of chemical reaction, the acid phosphate of lime (formed from one-half of the basic phosphate by the action of the acid) reacts upon the remaining undecomposed basic phosphate, producing the intermediate neutral phosphate of lime, $\text{CaO}, 2\text{HO}, \text{PO}_3 + 3\text{CaO}, \text{PO}_3 = 2(\text{CaO}, \text{HO}, \text{PO}_3)$.

In his studies concerning superphosphates, R. Jones, assistant at the Kuschen Experimental Station, comes to the following conclusions as the result of a long series of interesting and careful experiments:—

(1). The superphosphates are not unchangeable mixtures of gypsum, acid phosphate, and undecomposed basic phosphate of lime; but they contain the soluble phosphoric acid in the form of free phosphoric acid and acid phosphate of lime, the insoluble phosphoric acid as basic and neutral phosphate, and, in rare cases, in combinations which stand between the neutral and acid salts. Sulphuric acid is contained in them in the form of gypsum, and only exceptionally do any considerable quantities of free sulphuric acid appear to occur in them.

(2). These different chemical combinations are undergoing a constant interchange of elements; which decompositions produce, according to the external conditions and the quantity of sulphuric acid employed, an increase or a decrease in the amount of soluble phosphoric acid.

(3). A decrease takes place in every superphosphate, independent of the amount of sulphuric acid employed, where it loses in water, either by the action of artificial heat, or from long exposure to dry air. Again, "going

back" (or the conversion of phosphoric acid from soluble into insoluble forms) takes place, independent of the amount of water which they contain, in such superphosphates which contain a large amount of basic phosphate of lime, in consequence of the employment of an insufficient quantity of sulphuric acid.

(4). An increase in the amount of the soluble phosphoric acid can only take place where, in consequence of the use of large quantities of sulphuric acid, the insoluble phosphate of lime contains more phosphoric acid than is present in the neutral phosphate.

The preceding observations have reference, it is true, more especially to the continental high-grade superphosphates, which, when freshly manufactured, contain from 10 to 25 per cent of soluble phosphoric acid, equivalent to from 20 to 50 per cent of bone phosphate dissolved, but they apply also to the articles prepared and sold in America. These latter, being manufactured from articles containing basic phosphate of lime, carbonate of lime and iron, oxides of iron, magnesia, and alumina (partially joined to phosphoric acid), present for our study causes of a reduction of the soluble phosphoric acid other than the large amount of originally unacted-upon basic phosphate of lime, always present in superphosphates prepared from South Carolina rock by the application of a comparatively small quantity of sulphuric acid. In this case, whatever carbonate may have remained undecomposed will most likely suffer decomposition from the action of acid phosphate of lime, the results being the liberation of carbonic acid and the substitution of the metallic oxide (previously combined with carbonic acid) for atoms of water in the acid phosphate; thereby reducing it to the insoluble condition. Whatever free alumina or peroxide of iron may be present in the superphosphate acts in a similar manner. Where sulphate of iron or alumina have been formed by the action of sulphuric acid, there is no reason to fear a direct exchange of elements between them and the acid phosphate of lime. At another time I hope to speak of the modifications of these reactions produced by the liberal use of alkaline chlorides.

Having thus endeavoured to introduce some of the causes for the decrease in soluble phosphoric acid of old superphosphates, I would here call attention to various methods which have been employed to determine the degree of reduction. It is well to state that the desideratum is a method by which the amount of the decomposed phosphate of lime in a superphosphate can be determined; the soluble phosphoric acid having been previously extracted by water. This decomposed phosphate, whether wholly or partly a lime salt, may be either the neutral or the precipitated basic phosphate. It is requisite that the solvent for the decomposed phosphate shall not attack to any considerable extent the undecomposed phosphatic basis of the superphosphate, otherwise the results are indeed questionable. The weaker vegetable acids* have been recommended as fit solvents for the reduced phosphates, but they are liable to the above objections. Again, the ammoniacal salts of carbonic and certain vegetable acids† have been used for a like purpose. Without entering upon a detailed criticism of the results of the treatment of superphosphates and pulverised raw phosphates by other chemists, nor upon my own investigations in this direction, I would mention that the bicarbonate and succinate of ammonia do not dissolve the neutral and freshly precipitated phosphate in a sufficient degree to allow of their use. The oxalate of ammonia is an admirable solvent of these phosphates, but, unfortunately, it attacks the raw basic phosphate so as to vitiate the analytical results. The neutral citrate of ammonia, however, while it dissolves nearly entirely the neutral and

* J. A. Cheesbire, *CHEMICAL NEWS*, July, 1869.

John Hughes, *ibid.*, August, 1869.

Francis Sutton, *ibid.*, October, 1869.

† Dr. J. König, *Annalen der Landwirtschaft*, bd. 58.

Dr. Fresenius, *Zeitschrift für Analytische Chemie*, x.

* *Annalen der Landwirtschaft*, b. 56.

freshly formed basic phosphates of lime (as also those of alumina and iron, König) dissolves but very slightly the finely ground mineral phosphate.

Thus König found by boiling for one half hour a weighed amount of ground Lahn phosphorite, rock not dissimilar to South Carolina phosphate, in a sufficient quantity of neutral citrate of ammonia, that less than 2.50 per cent of phosphoric acid, or about $\frac{1}{10}$ th of that in the rock, was taken into solution. On the other hand, Fresenius, who does not allow the temperature of the mixture to reach blood-heat, did not dissolve more than $\frac{1}{10}$ th of the phosphoric acid. The difference in these results may be due to the difference in the temperature of the neutral citrate of ammonia while acting upon the phosphate.

In the following determinations of dissolved phosphate I followed the method prescribed by Dr. Fresenius in his *Journal of Analytical Chemistry*, and published a year ago.

(1). My first object was to ascertain the effect of the neutral citrate of ammonia upon the finely ground mineral phosphate. To this end a sufficient quantity of the reagent was allowed to act upon the fine phosphate for half an hour at a temperature of about blood heat.

Material A.—Sample of the phosphatic dust from over the mill stones of the Steno Works, kindly furnished me by Dr. St. Julien Ravenel.

B.—Sample of a cargo of Coosaw River phosphate, ground exceedingly fine by hand. This cargo had been ascertained to contain 27.20 per cent phosphoric acid by Dr. Aug. Voelcker, of London:—

	Before Treatment.	After Treatment.
A. PO ₅	26.86 W.	24.28
"	27.22 W.	24.22
Average	27.04	24.25
B. PO ₅	27.29 S.	—
"	27.12 W.	—
Average	27.20	24.75

The analytical results marked with W. are by my assistant, Dr. W. D. Wamet; those with S. are my own. The determinations of phosphoric are always, unless it is stated to the contrary, by the molybdate of ammonia method.

The above analyses give a difference of 2.79 per cent for A, and 2.45 per cent for B, in the amounts of phosphoric acid before and after treatment with the neutral citrate of ammonia. Bearing in mind the low temperature of the above digestions, the probability seems warranted that, in this finely divided condition, the South Carolina phosphate is soluble to the extent of 1 part in 10 to 12 in the reagent employed. If these figures are corroborated by additional analyses which I propose instituting at an early day, the greater value of these local phosphates will be established, since they will be shown to be easier decomposed by the weaker class of solvents.

It must be remarked, however, that the physical condition of the material acted upon was, from its extreme fineness, remarkably adapted for the action of the solvent; much more so than the coarser ground rock which serves as the base of the ordinary superphosphate.

(2). A number of ammoniated superphosphates which had been manufactured during the fall and winter of 1870-71, and analysed at that time by me, were subjected to a second analysis during the past winter, more especially with a view of ascertaining the condition of the phosphoric acid in them.

The first determinations of phosphoric acid were executed by the protochloride of uranium method, as is customary in this laboratory with freshly prepared fertilisers; the subsequent ones by the molybdate of ammonia method, with the exception of those for the soluble phosphoric acid, which were made by the previous method.

The articles examined were:—

A. Superphosphate containing a very small quantity of fish scrap.

B. Superphosphate ammoniated with a larger amount of fish scrap and with Peruvian guano.

C. Superphosphate ammoniated as the previous one.

D. Superphosphate ammoniated with dried flesh and guano.

	Analyses in 1870-71. Phosphoric Acid.		Analyses in 1871-72. Phosphoric Acid.		Loss in Soluble Acid.	
	Soluble.	Insoluble.	Soluble.	Reduced.	Insoluble.	Excess of Reduced over Loss in Soluble.
A.	3.74	—	3.34	2.19	14.70	0.40 1.79
B.	2.68	11.73	2.55	1.85	13.12	0.13 1.72
C.	4.38	8.43	3.42	2.32	9.27	0.96 1.36
D.	4.31	8.72	3.45	2.91	10.70	0.86 2.05

In nearly every case the percentage of total phosphoric acid in the old fertiliser will exceed that in the new by from 2 to 3 per cent; this increase being due to the loss of moisture, which ranges from 10 to 15 per cent in the ordinary superphosphates, as a result of their being kept through the hot summer.

Additional analyses of samples of various fertilisers kept in my laboratory for several years show similar results.

E. A superphosphate analysed in spring, 1869.

F. Ditto, ammoniated with flesh, analysed in summer, 1869.

G. Ditto, ammoniated with sulphate of ammonia, male and analysed in winter 1869-70.

H. A superphosphate which, while in bulk, was thoroughly drenched by a freshet in the fall of 1870, kindly furnished me by Dr. St. Julien Ravenel.

	(1). Analyses, S. Phosphoric Acid.		(2). Analyses, W. Phosphoric Acid.		Loss in Soluble Acid.	
	Soluble.	Insoluble.	Soluble.	Reduced.	Insoluble.	Excess of Reduced over Loss.
E.	5.86	8.26	3.95	4.35	5.70	1.91 2.44
F.	4.55	10.27	3.68	3.85	8.78	0.87 2.98
G.	5.54	—	2.93	4.26	11.67	2.61 1.65
H.	—	—	—	2.53	10.02	—

The preceding analyses indicate very clearly the truth of the theories advanced with regard to the method of reduction of the soluble phosphoric acid, which process takes place pre-eminently at the expense of the mineral basic phosphate of lime. For, even allowing a solubility of the mineral phosphate in the neutral citrate of ammonia, to the same extent as we observed in the cases of the very finely powdered phosphate, i.e., $\frac{1}{10}$ th to $\frac{1}{12}$ th of the amount of phosphoric acid, there is still in most of the analyses a considerable quantity of reduced phosphoric acid in excess over the difference between the two determinations of soluble phosphoric acid, i.e., over the loss of phosphoric acid; or, in other words, the amount of reduced phosphoric acid is greater than the sum of the loss in soluble acid, plus that amount of acid which we have reason to believe would be taken up by the reagent employed.

Perhaps at another time we may return to this subject. At present we call attention to a few considerations which must have weight in the valuation of all old superphosphates.

As a result of the completed chemical action there will be a larger amount of decomposed phosphate in the old fertiliser than in the new. This decomposed phosphate consists of a smaller amount of soluble phosphate, and a larger amount of phosphate insoluble in water but soluble in the reagents which in their action nearest approach the processes of the soil.

Jones found, in his investigations above cited, that the different phosphatic bases on being treated with sulphuric acid in proportion to their percentages of phosphoric acid (as also of carbonate of lime contained in them) afforded different results. Thus, old superphosphates made from Navassa burnt bone, and a mixture of the latter with phosphorite contained a comparatively large amount of neutral phosphate of lime; while those manufactured from Baker's Island guano, and the Spanish phosphate contained less neutral and more decomposed basic phosphate of lime; the larger amount of neutral phosphate in the former being most likely produced by the action of the reducing agents before mentioned (especially the oxides of iron) on the acid phosphate of lime.

Bearing in mind the greater richness in phosphoric acid of the neutral than the basic phosphate, since for the same amount of lime it contains nearly one-third more phosphoric acid, and its solubility in weak reagents, it is not strange that Picard should have expressed himself as follows:—"It is hence impossible to estimate their value (superphosphates) by their percentage of soluble phosphoric acid, since one which is deficient in phosphate soluble in water can contain much which is decomposed. Therefore it follows—what at first appears paradoxical—that the value of a superphosphate as a manure is raised by the decrease of its percentage of soluble phosphoric acid, which, as is well-known, is contrary to the ordinary usage in estimating the value of a fertiliser."

Does, then, in our experience, a superphosphate diminish in value by remaining in store for a year or even longer? In the absence of the direct answer, which must come from the agriculturist, the following considerations will have weight in forming an opinion on the subject. And since the pure superphosphates are used to only a small extent, comparatively, in the South, we will consider at once some of the changes produced in an ammoniated superphosphate, such as is generally employed, by being kept over a season:—

(1). There is a relative gain in weight of the valuable ingredients from a loss of a greater or less quantity of moisture. (2). The ammoniacal matter suffers a moderate decomposition, by which it is made more easily assimilable by the plant, without losing much, if any, ammonia; provided a sufficient quantity of sulphuric acid was originally employed. (3). As a result of the effects of heat and pressure the fertiliser becomes more uniform in composition, and is physically improved by the disappearance of the small particles of mineral and organic matter. (4). There is a loss in the amount of soluble phosphoric acid, whether free or combined, and an increase in that of the phosphates soluble in those reagents which approximate the solvents of the soil.

It is unnecessary here to dwell upon the well-known precipitation out of solution of phosphoric acid and phosphate of lime, in every well-drained and chemically considered normal soil. It is in view of this fact that chemists regard the chief function of sulphuric acid in a superphosphate to be that of disintegrating the mineral phosphate, so that, when the article is brought into the soil, the then precipitated particles of phosphate can be readily absorbed by the plant. The ultimate action of the acid in some cases, as may be inferred from the preceding pages, is little else than that of a complete chemical subdivision.

On the other hand, the solubility of a salt renders its equal distribution through a soil much more perfect than the most careful system of manipulation can produce with an insoluble one, and this is, perhaps, the great advantage derived from the use of a highly soluble phosphate. Whether this physical and certain chemical advantages, such as its quicker reaction on, and liberation

* The writer cannot, without further experiment, indorse this opinion, since the circumstances which led Dr. P. to this statement are widely different from those in America. Dr. P. has reference undoubtedly to superphosphates which contain originally much more soluble phosphoric acid than those used here.

of, the dormant nutritive elements of the soil, more than compensate for the advantages above enumerated, we must leave to be answered by comparative field experiments. I will add that, so far as I have been able to learn, the experience of the planters has shown no difference between the effects of freshly prepared and old fertilisers.

The statements of M. Alfred Dudeney* are the only authority on this subject which I have been able to collect from the foreign journals. In his article "On the Superphosphate of Lime and its Manifold Effects," he writes:—

"A commencement has been made in France to use the precipitated phosphate or the neutral phosphate,† which offers the phosphate of lime to the plant precisely in the condition in which the acid phosphate returns for absorption by the spongelike of the radicles. We have had comparative experience which has shown to us the good effects of the precipitated phosphate, effects at least as pronounced as those of the acid phosphate, the amounts of phosphoric acid applied being the same. This equality of effect must, in our estimation, depend on the minute division of the precipitated phosphate, and also upon the nature of the soil previously well manured, and thus containing a large quantity of carbonic acid, and of potash ready for assimilation. But still we give our preference to the acid phosphate of lime, and for these reasons." The reasons are those previously mentioned by me. In conclusion, then, we can expect good results from the use of precipitated or reduced phosphates in a soil rich in organic matter, and thus capable of affording a large amount of carbonic acid, the great solvent of plant food.—*American Chemist*.

ON THE ENERGIES OF THE IMPONDERABLES, WITH ESPECIAL REFERENCE TO THE MEASUREMENT AND UTILISATION OF THEM.*

By the Rev. ARTHUR RIGG, M.A.

(Continued from p. 39).

LECTURE II.

The Energy of Gravity, with especial reference to the Measurement of it.

THE energy of gravity is one of the most silent and all-pervading of the energies of the imponderables. Although we may not be conscious of the fact, there need be no doubt that, were this energy to cease, we should be like those whom Milton describes as

"Upwhiled aloft
And sent transverse, ten thousand leagues away,
Into the devious air."

This calamity is averted by gravity putting forth that energy allotted to it by the Creator, and the work thus done enables us now to sit at ease, and gives us houses in which to dwell.

If, then, it be asked, where do we find this energy? we may say, "Look around." In this room, gravity, inasmuch as we are at rest, produces but a static action; there is, however, a clock ticking, and there gravity is producing motion. The combined harmonious operations of the energies of gravity and vitality brought us together this evening. Thus it has been ever since the creation of man; and yet there is good reason for the surmise that the energy of gravity, even if known, was little regarded in the earlier ages of the world. A history of observations

* *Journal d'Agric. Pratique*, No. 13, 1872.

† The neutral phosphate of commerce is a precipitated phosphate, formed by the precipitation of soluble phosphate with burnt lime or the carbonate of lime. Dr. N. A. Pratt has recently kindly furnished me with a sample of precipitated phosphate of lime, as prepared by his patent process. The percentages of phosphoric acid and lime in this article have been found, in my laboratory, to coincide pretty nearly with the formula $2CaO, 11O, PO_5$, or the neutral phosphate of lime. I have prepared for my own experiments this same salt by the action of chloride of calcium in excess upon the common phosphate of soda.

on the energy of gravity, or even of traces of the recognition of this energy in those ages, has yet to be written. Whether, by some of the early Greek writers, gravity was supposed to be a power innate, as a living principle—a spirit in every particle of matter; or whether this power had a residence at the centre of the earth; or whether it resided in an atmosphere surrounding each particle of matter; or whether Seneca, who lived about 38 A.D., was moved, by a consideration of (to him) that mysterious principle we call gravity, to notice that the tides and the moon were somehow related, need not this evening concern us.

From the time of Seneca we may pass over more than fifteen hundred years, to the days of Galileo (A.D. 1600), who was perhaps the first person to notice that bodies in falling moved faster and faster. He attributed this to the effects of gravity, and considered that if he could retard speed whilst still permitting gravity to act, he might determine the law of increasing spaces in equal successive times. This he did by permitting a ball to roll down an inclined plane; friction on the plane caused the retardation, whilst gravity alone caused the motion. Thus he obtained the ratio of spaces in reference to succeeding times; but he made no attempt to measure the absolute spaces when a body fell freely.

Next to Galileo, in order of time, must be placed Kepler, a German astronomer, who, about 1615, in his search after certain astronomical relations, existing apparently through the mutual attraction of the planets each on the other, was led to surmise respecting the universality of the mutual influences of material bodies.

The succeeding fifty years present a blank in reference to inquiries or investigations respecting gravity. Then came Robert Hooke, who was at the same time a mathematician, an astronomer, and a mechanician. He was secretary to the Royal Society of England, and, from 1669 to 1674, seems to have frequently turned an inquiring mind to the nature of that influence which he thought he could observe to be exercised by the sun and earth upon others of the planetary system.

The great, and now (1873) universally recognised, law upon this subject was first laid down by observations and reasonings of Sir Isaac Newton, which, even at this day, are regarded with an almost religious veneration by the advanced and intelligent men of every nation. Although it is said that Newton began in 1670 to form more clear conceptions of the law of gravitation than had been propounded by any of his predecessors, we must remember on what surmises he had to build.

Kepler, about 1615, and Robert Hooke, about 1666, had led Newton, so early as the above-named date (1670), to form these conceptions, and it is probable that he was confirmed and directed in his anticipation by the fact that Richer noticed, in 1672, that a pendulum conveyed from Paris (lat. 48 deg. 30 min. N.), long. 2 deg. 20 min. E.) to Cayenne, in South America (lat. 4 deg. 56 min. N., long. 52 deg. 20 min. W.) did not vibrate in the same time. This recorded fact was as a demonstration to the mind of Newton of the deviation of the figure of the earth from perfect sphericity, and its oblateness, or compression at the poles. It was not, however, until the publication of his "*Principia*," in 1687, that the law of gravitation was fully established and enunciated.

Briefly expressed, the law, as anticipated by others and propounded by Newton, is this—that the attraction of one planet upon another depends upon the masses (not upon the "weights") and distances of the two planets; not, however, is the law of increase or decrease such, that at one half of a distance or double of any distance is the intensity of the attractive force doubled or halved. This might be a first impression. Astronomical facts refused to conform themselves to such a law. They rebelled. The parliament of planets had prescribed another code for the inter-relationships of their mutual attractiveness, and although it might per-

haps have been readily inferred that, as the distance between the attracting bodies was increased, the intensity of attraction would be decreased, yet the law of that decrease was the one which Sir Isaac Newton announced. It is this—that if there be two heavenly bodies, say, the earth and the moon, and that these at a known distance are mutually exerting a certain attraction or drawing each to the other; then, if the distance be doubled, the influence will only be one-fourth of what it was. If the distance be trebled, then this influence will become one-ninth of what it was; if quadrupled, then one-sixteenth of what it was. Expressed in precise phraseology, the law of gravitation is that of the inverse square of the distances. Thus far satisfied the requirements of astronomers.

It is remarkable how much of the utilised information men possess has been derived from the observations of astronomers. The mechanism of the universe was known before Harvey discovered the circulation of the blood, or Watt constructed a steam engine. The astronomers seem to have been the pioneers of every branch of human knowledge. The Old and the New Testaments open astronomically. "In the beginning God created the heaven and the earth" (Gen. i., 1). "The wise men from the east came to Jerusalem, saying, where is He that is born King of the Jews? for we have seen His star in the east" (Matt., ii., 2).

It must be remembered that the science of astronomy in one important respect differs from all other sciences. Astronomers are observers only—they ascertain causes by watching effects. They cannot interfere with or alter the causes in operation. They cannot make experiments. That man presumed too much upon the powers of his astronomical friend who, having invited him to bring some of his acquaintance to see an eclipse of the moon by the aid of a telescope, and, arriving too late, assured those who accompanied him that the astronomer was not only a personal friend, but also a very kind-hearted man, and he did not doubt that the eclipse would be done again in order that they might see it. Yet upon these observers all experimenters erect their fabrics. The gigantic and uncontrollable phenomena, and all the laws of the universe of planets—of the ebb and flow of the tides, of meteorology, of terrestrial magnetism and its connection with the sun, are the results of observation. They could never have been known by experiment; indeed, we could not so interfere with them as to make an experiment. Remember, experiment is an interference on our parts, and a re-directing of energy into a new channel, in order that that may be observed which cannot otherwise be observed. Hence, if we wish to utilise observation it must be by the adaptation of an experiment in the presence of an observation—to contrive, in fact, a system of apparatus which may enable us to take observations, and at the same time to so control the elements of an experiment as to bring them within the range of our means of observation.

Such combination of experiment and observation is to occupy much of our attention this evening, as on the records of these men—Cavendish, Atwood, Kater, Sabine, and Baily, especially Captain Henry Kater, are built our system of measures and weights; for to them we are indebted for what must constitute a court of final appeal, should the time ever come when our present standards, being totally lost, it is essential to re-establish them.

The energy of gravity is peculiar, and differs from those other energies with which we are to be concerned, in that it seems inexhaustible—its power is not proportioned to the work it does. All other energies are in process of exhaustion by work when that work is measured by motion; not so gravity. Imagine a large ball, and a second small one which gravitates towards it—the number of these small balls may be increased, and still the influence of gravity on each ball is as intense as though there was only one small ball; no exhaustion from work done affects the energy of gravity, and yet it

seems not to have any power of recouping its expended energies. There is no elasticity about it—at least, none in the hands of men.

For example, we can, in food, avail ourselves of affinity, and so, through the agency of assimilation, receive the energies of an exhausting vitality. Electricity can, upon a system of relays, or upon its extraordinary property of induction, renew at a distance, not only its pristine vigour, but an energy many-fold greater than its original one. Light can have its intensity and purity restored by heat. Gravity remains in its solitariness. True, we believe that vitality, affinity, electricity, light, and heat are independent of, and beyond the influence of, gravity; yet we know them not—we cannot bring them within the ken of our senses, except when they are associated with what owns the dull, dead, inert, and yet powerful influence of the energy of gravity. For all means yet employed have failed to develop or detect the presence of these imponderables in a perfect vacuum.

This fact seems to give support to the suggestion that the "potential energy of gravitation may be, in reality, the ultimate created antecedent of all motion, heat, and light at present existing in the universe."

The mode in which we estimate or measure gravity is peculiar. It is the only one of those energies with which this course of Cantor lectures has to deal that tells its story upon a scale-beam or spring balance. No concentrated rays of a tropical sun have ever caused an appreciable deviation of the most delicate balance; neither light nor heat imparted to a body *in vacuo* has ever required the fraction of a gramme to be added to the other scale-pan. But, when gravity is concerned, we cannot add the most minute microscopical molecule without having the equilibrium disturbed.

Gravity alone, of all the imponderables, rises up equal to the burden laid upon it. Its power seems to increase with the amount of matter involved or work to be done. The more required from it, the more it does. You cannot overburden it. An avalanche of rocks or a gossamer thread are equally the playthings of gravity.

For the purpose of these Cantor lectures, the law of gravitation which binds the planets in their courses is of little concern, unless we find that the same law binds the material elements with which we are concerned. The question whether the influence whose law Sir Isaac Newton so clearly propounded resulted from an unknown and ungovernable something, resident and centralised, as it were, within the planets, or whether it was a property of every molecule or group of molecules, was not set at rest until Nevil Maskelyne, the Astronomer-Royal at Greenwich, went to Mount Schiehallien, in Perthshire, in 1774, to calculate the density of the earth.

The mountain of Schiehallien has very steep sides. Mr. Maskelyne suspended plumb-lines from two opposite and nearly vertical sides. Now, if those plumb-lines deviated from what one may call verticality, they would have been caused to deviate by the attraction of the mass of the mountain. Thus Maskelyne examined this—he had an instrument by means of which he could, by observations upon the stars, determine the exact direction that the plumb-line should take, and he found that the strings did not take that direction. Having done that on one vertical side of the mountain, he repeated the experiment on the other side, and found that the deviation there was opposite to that which it was on the first side.* Having determined that these strings no longer followed the vertical, he formed an estimate of how much this mountain attracted the plumb-bob at the end of the string, and so arrived at a conclusion that each particle of matter does attract every other particle. This was the first approximation to an estimate

* The deviation was noted by a zenith-sector, and after making the requisite corrections there was left an attraction which caused the two lines to be drawn together, so including an angle of 12 seconds due to the mountain.

of that which forms a very important element in connection with other experiments. We may here state that in certain regulator-clocks the makers put the single weight in the corner of the case, so that, being removed to the greatest distance, its influence upon the pendulum-bob, similar to that of Schiehallien upon the plumb-bob, may be the least possible.

This, then, established the fact that the power whose law Newton discovered was no gnome resident in some mysterious terrestrial centre, but was a property of every molecule of matter, and could not by any means or contrivance be separated from those molecules. Whether this property be within the molecule, or only in what may be called the atmosphere around the molecule, may be left to those who arrange theories.

(To be continued.)

NOTICES OF BOOKS.

Third Annual Report of the Deputy-Master of the Mint, 1872.

In this official report, with its fourteen appendices, we meet with a variety of important information. We learn, for instance, that the "machinery of the Mint was constructed between the years 1805 and 1816, since which time nearly every appliance of minting in other countries has been gradually changed, while in this country but little advance has been made, and the result is that, although the English Mint is bound by law to coin with much greater accuracy than foreign mints, its machinery is less efficient than that of even the least well-appointed mint in Europe." That such a state of things is not creditable to a country which boasts of being the fruitful mother of mechanical improvement will be readily admitted, and we have not the smallest doubt that such impediments are a "constant source of anxiety" to the Department, and of needless expense to the nation.

The differences of assay reports come very naturally here under notice. We read that "when the reports of the Assayer of the Mint, by whom gold ingots imported for coinage are assayed, do not agree with those of the trade-assayers by which the ingots are accompanied, the former almost invariably indicate the presence of less gold than the latter." It is a fact but too well known to the initiated that large operators in bullion generally press the assayer to give high returns. If he, feeling certain that he is right, declines to "cook" his results, they withdraw from him, their patronage. Thus a class of "high" assayers have sprung up, whose reports very naturally do not agree with those of the Assayers to the Mint.

The Annual Report gives some curious information concerning the coinage of other countries. We learn that in Japan the mint is being placed upon an improved footing, and that large sulphuric acid works, under the direction of an English superintendent, are in course of erection.

The most interesting portion of this pamphlet is naturally the "Memorandum" of Mr. Roberts, the able and energetic Chemist to the Mint. According to this document, 30,334 assays have been made during the year—19,466 of gold, and 10,888 of silver. The amount of "brittle gold," set aside as unfit for working, was 17,000 ozs., whilst, during the year before, it was no less than 40,000 ozs. Mr. Roberts is enabled to state, as the result of his experience, that the "chlorine process" for toughening brittle gold is the most effectual method hitherto devised. The new process of spectroscopic assaying devised by Mr. J. N. Lockyer, F.R.S., has been experimentally tested. Mr. Roberts is of opinion that the use of the spectroscope for quantitative analysis well deserves careful examination. He states that, whilst the existing method—the gold-parting assay—"affords results

which are trustworthy to the 1-10,000th part of the weight of the assay piece, in the examination of a series of gold-copper alloys by means of the spectroscopic differences of composition more minute than the 1-10,000th part can be readily distinguished. By the spectroscopic method, too, the value of the assay piece can be determined in a few methods, whilst an assay by the ordinary method can hardly be completed in less than two hours. Mr. Roberts does not describe the exact method of manipulation, which has not been finally decided upon.

Traces of gold, enough to render their separation remunerative, have been found in the worn-out silver coinage, and in this manner 81.27 ozs. of gold have been recovered from 117.048 ozs. of old crowns and half-crowns. Among the appendices is an interesting, but long, correspondence on the preparation of new trial-plates of gold and silver.

which followed several other letters between us on different kinds of fat. *Littera scripta manet*. I have seen nothing yet to disturb my views, or throw any new light on the matter; but I do not like my labours to be altogether ignored, notwithstanding it is twelve years ago since my communications were made in the *CHEMICAL NEWS*.—I am, &c.,

JOHN HORSLEY, F.C.S.,
Analyst to the County of Gloucester.

Cheltenham, July 29, 1873.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopaedic list of chemical papers published abroad during the past year, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, July 7, 1873.

Heat of Combination in reference to the Solid State; a New Thermic Expression of Reactions.—M. Berthelot.—A thermo-chemical paper. The author gives an account of the heat of solution of monobasic salts, including formates, acetates, benzoates, picrates, nitrates, chlorides, bromides, iodides, cyanides, &c.; of the bibasic salts, sulphates, oxalates, tartrates, and carbonates. He then examines the relations between the heats of solution, the formation of crystalline hydrates, of acid and double salts, the reciprocal displacement of acids in salts and saline double decompositions.

New Isomer of Valerianic Acid.—C. Friedel and R. D. Silva.—The authors have in a former communication described pinacolic alcohol derived from pinacoline by hydrogenation, and have announced that the oxidation of this alcohol reproduces pinacoline, and that the latter, in turn oxidised by bichromate of potassa and sulphuric acid, yields an acid isomeric with the valerianic. They have since continued the study of this acid, which they have named *pinic*. They observe that it has a considerable resemblance to the trimethylacetic acid of Boulewer.

Mode of Decomposition of Explosive Bodies, Compared with the Phenomena of Supersaturation.—P. Champion and H. Pellet.—The name of explosives is given to compounds or mixtures which under various circumstances liberate a volume of gas whose rapid formation causes an explosion more or less powerful. In certain cases, as in the powders of which common gunpowder is the type, the explosion is derived from combinations between the elements which compose. In others, as in the substances of indefinite composition—such as the ethers of the mono-atomic and poly-atomic alcohols, the fulminates, the compounds of nitrogen with several non-metallic elements, &c.—the explosion results from the violent separation of the elements. This definition appears limited to a restricted number of phenomena, whence the authors have concluded that, in order respectively to distinguish bodies with regard to their rapid decomposition, a classification into stable and unstable would be more appropriate to this kind of phenomena. From this point of view we might designate as unstable the bodies or compounds in which the equilibrium, if broken in one point and under given conditions, determines the immediate decomposition of the whole mass with a rapidity and an evolution of heat depending

CORRESPONDENCE.

ON BUTTER.

To the Editor of the Chemical News.

SIR,—I cannot agree with Mr. Martin Murphy that the fat globules in milk have no "enveloping tissue or coating." A drop of milk under the microscope—using 1-50th focal length—shows the field full of capsules containing fat, with a small proportion of free oil globules, some being very minute. When treated with acetic acid the globules coalesce; but chloroform does not dissolve the fat in the capsules without agitation, whilst the free oil globules instantly vanish into that liquid.—I am, &c.,

CHARLES A. CAMERON.

Dublin, July 29, 1873.

ON BUTTER.

To the Editor of the Chemical News.

SIR,—In addition to the methods for the detection of the adulterants in butter, which have of late appeared in the *CHEMICAL NEWS*, would specific gravity not be of importance if carefully applied? Supposing a portion of butter was taken, melted, raised to a temperature sufficient to melt the bodies resulting from a mixture of pure butter with an adulterant—so that their specific gravities could be compared at the same temperature—and its specific gravity taken.

Makemixtures—say with 1 to 10 per cent of the adulterant and pure butter; get these to the same temperature ascertain their specific gravities, compare with pure butter, and note the difference.

Specific gravity is very useful in many such examinations. If any one has tried experiments of that nature on butter, and if it would not be too much to ask, I would, through curiosity, like to know a little of the results.—I am, &c.,

GEORGE ALSTON.

London, July 22, 1873.

THE BUTTER CONTROVERSY.

To the Editor of the Chemical News.

SIR,—With all due deference to Dr. Campbell Brown, as I was so much longer in the field on this subject than Dr. Ballard, it would have been but courteous if he had begun at the beginning; as Dr. Ballard himself in his paper (see *CHEMICAL NEWS*, vol. iv., p. 283) alluding to my communication (vol. iv., p. 230), as also in vol. iv., p. 309, admits that I was about the first to publish anything like a satisfactory test on the subject; and in that very paper (vol. iv., p. 309) I called attention to the microscopic characteristics of butter and lard, after

on the nature of the body and on the circumstances to which it is exposed. A great number of unstable bodies can manifest their change of state in different manners, either by a rapid decomposition giving rise to a true detonation, or by the more gradual separation of the component elements. Dynamite and gun-cotton, which can be decomposed by ignition, flame, or a violent shock (such as that of a detonator), present a striking example of these facts. The name which the authors propose might also be extended to modifications of the physical state. It is now only one step to compare the unstable state of equilibrium of explosive compounds with that of supersaturated solutions, as Gernez has done. The authors have sought to establish precise analogies between the phenomena which accompany the different modes of action of supersaturated solutions and of unstable compounds, among which they have selected dynamite, on account of the facility with which it undergoes decompositions of different grades. Supersaturated solutions may be considered as unstable compounds of water and of a hydrated salt, in which dissolution is effected by contact of a crystal of the same salt or its isomorphs. This crystal represents the detonating primer which effects the rapid decomposition of nitro-glycerine. In fact, whilst a few decigrammes of fulminate of mercury induce the explosion of dynamite, iodide of nitrogen, sufficient in quantity to be mechanically equivalent to the fulminate, is unable to explode the dynamite. In presence of a suitable charge of fulminate of mercury, dynamite explodes, whatever is its quantity and whatever may be the form of the containing vessel. A sufficient weight of sulphate of soda, at ordinary temperatures, determines the crystallisation of supersaturated sulphate even in those cases of "desensibilisation" which will be examined below. The diameter of the tubes containing the sulphate of soda, and the shape of the recipients, are without influence on the speed of crystallisation. A supersaturated solution, enclosed in a tube with several elbows and having a length of 48 centimetres, has crystallised in the same time as a similar solution placed in a straight tube of the same length. If the primer is insufficient, the dynamite undergoes merely a partial decomposition, and in certain cases does not ignite. On its part, supersaturated sulphate of soda presents different crystallisations, resembling the modes of action of the primer. Supersaturated solutions crystallising under the influence of particles of sulphate of soda contained in the air, yield long crystalline needles. If, on the contrary, voluminous crystals of sulphate of soda are introduced into the solution, a confused crystallisation prevails, and the crystals appear partly broken. The addition of an inert body in excess (silica, &c.) to nitro-glycerine completely modifies its sensibility, and transforms it into a compound which even resists energetic shocks. A corresponding result is obtained with supersaturated solutions. To 50 c.c. of a supersaturated solution of sulphate of soda were added—

		Crystallisation, caused by Atmospheric Dust, is Effected in—	
		Seconds.	
Water, 2 grms.	.. .. .	37	
Glycerine, 2 grms.	.. .. .	41	
Chloride of sodium, 2 grms.	.. .. .	40	
Nitrate of potassa, 2 grms.	.. .. .	51	
Carbonate of soda, 2 grms.	.. .. .	62	
Sulphate of ammonia, 2 grms.	.. .. .	64	
Sulphate of soda, 46 grms., in water, 72 grms.	.. .. .	114	
Replacing the glycerine with syrup of sugar, 100 grms.; water, 50 (?)	.. .. .	177	
Glycerine at 25°, 12.5 c.c.; super- saturated sulphate of soda, 25	.. .. .	360	
Water, 72 grms.; sulphate of soda, 46 grms., saturated with car- bonate of soda .. .. .	.. .. .	900	

If, to 25 c.c. of a solution of supersaturated sulphate of soda, we add 12.5 c.c. of a solution of nitrate of potassa

saturated in the cold, the mixture can be left exposed to atmospheric dust without effect. Crystallisation can only be induced by the direct introduction of sulphate of soda in crystals of an appreciable bulk. The addition of foreign bodies acts, therefore, in a similar manner both with nitro-glycerine and with supersaturated solutions, which results from the separation of the molecules, and the difficulty which each experiences in undergoing the influence of the neighbouring molecule. As to the action of temperature, by reason of the very nature of the phenomena between which it is sought to establish analogies, we comprehend that their action must be inverse in the two cases, in order to give place to comparable phenomena. At low temperatures the explosive power of dynamite, and of explosives in general, decreases notably, whilst, in the same conditions, the instability of supersaturated solutions augments rapidly. A charge of 0.2 c.c. of fulminate of mercury is without action upon dynamite at 75° cold. A supersaturated solution of sulphate of soda, placed in a tube, crystallised in 39 seconds at a temperature of 15° to 16°; whilst, at 8°, the crystallisation was completely effected in 19 seconds with the same depth of liquid. A similar inversion of results was again produced on introducing into a supersaturated solution a pulverulent body, and if, reciprocally, the silica, which serves as an absorbent for nitro-glycerine, is replaced by any solvent. Wood-spirit, added to nitro-glycerine in the proportion of $\frac{1}{4}$ to $\frac{1}{2}$ per cent, prevents it from exploding, but, in this case, the very nature of the body is seriously modified. On the other hand, the presence of a sufficient quantity of an absorbent, like silica, prevents supersaturation. In these experiments with dynamite, the nitro-glycerine may be replaced with any analogous compound, such as nitro-glycol, nitro-erythrite, &c. The foregoing series of facts appear to the authors sufficient to establish a direct relation between the phenomena of supersaturation and those presented by explosive bodies.

Transformation of Succinic Acid into Maleic Acid.—M. E. Bourgeois.—Maleic acid has been converted into succinic acid in certain phases of fermentation, and the same transformation is effected in an analogous manner and more regularly under the influence of hydrogen. The author has observed an inverse reaction, whilst examining the effects of heat upon the succinate of silver; part of this salt is split up into silver and maleic acid, according to the following equation:— $C_4H_4Ag_2O_8 = Ag_2 + C_4H_2O_8$.

Action of Chloride of Benzyl upon Naphthylamine.—Ch. Frété and E. Tommasi.—On causing chloride of benzyl to react upon naphthylamine in heat, in presence of a small quantity of zinc-powder, the authors obtained a compound isomeric with cresyl-naphthylamine, but differing from the latter in the substitution of an equivalent of benzyl for an equivalent of cresyl. Benzyl-naphthylamine melts at 66° to 67°, whilst its isomer melts at 79°. Its composition is—

Carbon	87.53
Hydrogen	7.20
Nitrogen	5.34

Experimental Researches on the Action of Nitrous Oxide Gas.—F. Jolyet and T. Blanche.—A physiological paper. The authors conclude, from their experiments, that pure protoxide of nitrogen cannot maintain the respiration either of plants or animals. Seeds refused to germinate in an atmosphere of this gas.

Crystalline Forms of the Lanarkite of Scotland.—All. Schrauff.—The crystals measured by the author contain no more carbonic acid than those analysed by Pisan.

New Clinical Researches on the Localisation, in the Anterior Cerebral Lobes, of the Action by which the Brain Concurs in the Psycho-Physiological Faculty of Speech.—M. Bouilland.—The author distinguishes two centres in these lobes—one having reference to the act of pronunciation the other to the words themselves.

Optical Telegraphic System Realised, during the Siege of Paris, by a Commission Appointed by the Governor.—M. Laussedat.—This gives the contents of a sealed packet deposited with the Academy in April, 1872. (An Italian journal has recently described a similar system to that experimented with during the siege). The principle of the apparatus is this—Conceive two telescopes, *ab* and *a'b'*, directed towards each other so that their optic axes coincide. Behind the telescope *a'b'*, and near its eye-piece is placed a light, e.g., the flame of a candle. If the distance is not too great, and the observer looks through the telescope *ab*, he will perceive the image of the flame as a bright point. If the distance between the telescope is increased, it will be necessary to increase the intensity of the luminous source, or the aperture to the objectives. The brightness of the image, as seen through *ab*, depends on the elements now mentioned (intensity of source, distance, aperture) and on the state of the atmosphere. A screen is inserted and withdrawn at proper intervals, being worked with Morse instrument. The signals are rendered invisible to all but the operators. Such apparatus was furnished to some of the Paris forts; the maximum distance was that between Valerien and Fort de Nogent, 20 kilometres. A balloon left Paris in December, during the siege, with apparatus for connecting Paris thus with the provinces; and M. Lissajous gives a report of the attempts made, in some cases with success. The system was successfully used by day (and with sunlight) in General Chanzy's army.

Constitution of the Sun and the Theory of Spots.—M. Vicaire.—Reserved.

The Cyclones of the Sun Compared with those of our Atmosphere.—M. Tarry.—M. Faye, instituting a parallelism between solar and terrestrial cyclones, asserts a movement of rotation from above downwards. The Italian spectroscopists deny this descending movement as regards solar cyclones. The present writer asserts that, in the terrestrial, the rotatory aspiration is from below upwards. A whirlwind sucks up trees, roofs of houses, the water from ponds, &c. A cyclone passing over Sahara raises great quantities of sand, which afterwards fall, frequently, on the Mediterranean and in the south of Europe. Further, if the air were sucked down, it would become hotter as it descended, and the vapour it contained would not be precipitated in form of rain; now the passage of cyclones is always marked by heavy rains. This error of M. Faye's does not, in the author's opinion, vitiate his theory, which M. Tarry only wishes to put on a firmer basis. The cyclones in the sun suck up first hydrogen, then denser matters. The metallic vapours are condensed in the colder regions, and fall back in liquid drops to the interior. All the facts urged by the spectroscopists against M. Faye's theory become arguments in its favour, if we only modify the theory as stated.

Some Details of the Earthquake of June 29.—M. Fonvieille.—The centre of the catastrophe was in the Marino valley, in the district of Vittorino. Two days before, the lake of Santa Croce suddenly fell several feet, and rumblings were heard in a village on the north side on the 28th. Some streams which enter and leave the lake became muddy after the earthquake, one taking a red colour, as of blood. The churches contained a good many people, and several were killed by falling stones. The telegraph lines were broken at various points, showing great violence of oscillation. The earthquake was felt in Italy, in Germany, in the Tyrol, and even as far as Munich. A very violent whirlwind appeared at Vienna at the same time, carrying off the captive balloon to a distance of 30 kilometres. Other details are given.

Revue Scientifique de la France et de l'Etranger,
July 12, 1873.

This number contains a lecture by Prof. C. Bernard, on the "Formation of Sugar in the Liver and the Blood."

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, Tome xxxi., No. 11, July 10, 1873.

New Electric Pile.—M. Zaliwski.—The author takes two porous cells, one of which fits very loosely in the other. Into the inner cell, containing the carbon, he pours nitric acid; into the other, sulphuric acid; and into the outside non-porous containing-vessel, fitted up with a cylinder of sheet-zinc, a saturated solution of sal-ammoniac. The arrangement of the liquids is, therefore, nitric acid, sulphuric acid, solution of sal-ammoniac.

Artificial Butter.—Ordinary fats are composed of three substances—Stearin, which is as hard as wax; margarin, of the consistence of butter; and olein, a liquid. When these three are separated by chemical means, the first may be employed for candles, the second for butter, and the third for lubricating machinery. A company is at present operating upon beef-fat, at No. 45, Newark Street, New York. In taste and in appearance the butter thus made is exactly similar to the best butter made from cows' milk. Prof. Parof, the inventor, hopes to drive genuine butter completely out of the market. (Margarin may have the consistence, but can never possess the flavour, of butter, which depends upon small quantities of butyric, capric, and caproic acids; very similar operations are being conducted in England, the raw material being the fat of horses obtained from the knackers).

Albumen Obtained from Milk.—M. Schwalbe has found that by adding one drop of the oil of mustard to 20 grms. of cows' milk, the casein is transformed into albumen. If this discovery is confirmed, it will be of great importance in the art of calico-printing.

Natural Red Silk.—M. Ruimet des Taillies, writing in the *Chronique de la Société d'Acclimatation*, states that, by feeding silkworms on vine leaves, he has obtained cocoons of a magnificent red, and, by employing lettuce, others of a deep emerald-green. M. Delion de Saint Giers, of Vaudes, has obtained silk of a beautiful yellow, other samples of a fine green, and others again of a violet, by feeding the silkworms on lettuce or on white nettle. He points out that the silkworms must be fed on mulberry leaves when young, and supplied with the vine, lettuce, or nettle leaves during the last twenty days of the larval stage of their life.

No. 12, July 17, 1873.

Cure for the Bites of Gnats.—Claude Collas.—The remedy is the application of sinapised paper.

Means of Accelerating the Germination of Plants.—Dr. Grouven.—The seeds were steeped in an aqueous solution of nitrate of potassa, containing 5 per cent of the dry salt.

On Silica.—Dr. E. Robert.—Observations and speculations on the formation and transformation of siliceous minerals.

Properties and Uses of Kieserite.—A paper, extracted from the *Scientific American*, on the commercial applications of the Stassfurt salts.

Ozokerit Candles.—Ozokerit is found in beds in the sandstone of Slank, in Moldavia, in the neighbourhood of mines of coal and of rock-salt; it has also been discovered in the Carpathians. The material in its crude state is brown, greenish, or yellow; it is translucent at the angles, and its fracture is resinous. It is naturally brittle, but when softened can be kneaded like wax. It blackens on exposure to the air. It becomes negatively electric on friction, and exhales then the aromatic odour of a hydrocarbon. It melts at the low temperature of 66°. Its illuminating power is such that 754 ozokerit candles give a light equal to 89r of paraffin, or 1150 of wax.

Explosive Antimony.—If a slip of copper is attached to the negative pole of a battery, and a slip of platinum to the positive, and if these two electrodes are plunged into a solution of chloride of antimony, the latter meta-

is deposited upon the copper in a brilliant layer. After having been well washed, the antimony, which is very brittle, is detached. It detonates violently, with evolution of light and heat, if rubbed in a mortar or struck with a hammer.

Preparation of Stuffs against Moths.—Dr. Reimann recommends to steep the stuffs for twelve hours in the following solution:—Dissolve in hot water 4,534 kilos. of alum and 9,68 kilos. of acetate of lead. Let the sulphate of lead settle; draw off the clear liquid, and add 818 litres of water in which a little isinglass has been dissolved. After steeping, the goods are dried and finished in the ordinary manner.

Mineral Caoutchouc.—This remarkable substance, which is now imported from Australia, is found at Coorong in thin layers. On analysis, it appears to have a generic relation with petroleum.

Alcohol from Mosses and Lichens.—This manufacture has spread from Sweden to Russia, and is now carried on upon a large scale. The produce is considered of good quality, and is obtained to very great advantage.

No. 13, July 24, 1873.

This number does not contain any original chemical matter.

Zeitschrift für Analytische Chemie. No. 1, 1873.

Determination of Phosphoric Acid in Baker Guano and Similar Phosphatic Bodies.—C. Gilbert.

Appendices on the Same Subject.—R. Fresenius; Max Märker; G. L. Ulex.

Experiences in Chemical Jurisprudence. 1. Detection of Prussic Acid.—Heinz Struve.

Detection of Grape-Sugar along with Dextrine and Similar Bodies.

A Method of Determining Sulphur of General Applicability.—A. Sauer.

Precipitation of Magnesia.—F. Mohr.

Contributions to the Qualitative Examination of the Vine-Leaf.—C. Neubauer.

Comparative Determinations of Alcohol.—A. Kraft.

Analysis of Nickel and Cobalt Ores and Furnace Products and on a Convenient and Accurate Method of Separating Zinc from Nickel and Cobalt.—R. Fresenius.

Avoidance of Explosions in the Use of Apparatus for Generating Hydrogen Gas.—R. Fresenius.

Bulletin de la Société Française de Photographie.
No. 6. 1873.

Application of Aniline to Photography.—M. Tronquoy.—A solution is prepared containing sulphuric acid and some grammes of bichromate of potassa. A sheet of paper is saturated with this liquid in the dark; it is allowed to dry, and then placed under the design in a frame. The design is reproduced on the paper in a straw-colour. It is taken out, and exposed in a box to the vapours of aniline. By its action the bichromate and chromic acid not reduced take a colour varying from green to blue-violet. It is washed in abundance of water.

Photo-Chemical Researches on the Use of Gaseous Developing Agents, and on the Influence of the Molecular State as regards Sensibilisation.—M. Merget.—The gaseous bodies experimented upon were hydrogen, sulphide of hydrogen, and the vapours of iodine and mercury.

Dark Chamber called "Composition Chamber," making it possible to obtain a Landscape from Separate Positions, which are then Combined in Single Proof.—M. Debluë.—An account of an ingenious

contrivance which may probably prove of great importance in landscape photography.

Modifications of the New Carbon Processes called "Contact-Mariotype" and "Pressure-Mariotype."—A. Marion.—The new procedure is a combination substituting alum and blended papers for the fatty inks, without the intervention of light.

Polytechnisches Journal von Dr. E. M. Dingler,
No. 4, 1873.

Apparatus for the Quantitative Determination of Carbonic Acid in Saturation Gases.—B. Wackenroder.
Contribution to our Knowledge of Juniper Berries.—E. Donath.

Note on the Determination of Paraffin in Stearic Acid Candles.—E. Donath.

Formation of Vinegar.—L. A. Buchner.

Transfer of Photographic Membranes to Articles of Glass, Earthenware, and Wood.—J. Schnauss.

Archives des Sciences Physiques et Naturelles. June.

Absorption of the Chemical Rays by the Atmosphere of the Sun.—H. C. Vogel.

Bulletin de l'Académie Royale des Sciences des Lettres et des Beaux-Arts de Belgique, No. 5, 1873.

Derivatives of Glycerine.—L. Henry.

Chlorinised Aceto-Nitriles.—L. Bisschopinck.

On Iced Alcoholic Beverages Reduced to Very Low Temperatures.—M. Nelsens.

Remarks on the Volatility of Cyanic Compounds.—L. Henry.

MISCELLANEOUS.

British Association for the Advancement of Science.—In consequence of the illness of Dr. Joule he will be unable to preside over the meeting at Bradford, which commences on the 17th of September, and the Council have therefore appointed Dr. A. W. Williamson, F.R.S., to the office of President for the year. The following shows the Vice-Presidents and Officers of the Association, as well as of the various sections and departments:—Vice-Presidents elect—The Earl of Rosse, F.R.S., F.R.A.S.; Lord Houghton, D.C.L., F.R.S.; Mr. W. E. Forster, M.P.; the Mayor of Bradford; Mr. J. P. Gasiot, D.C.L., F.R.S.; Prof. Phillips, D.C.L., F.R.S.; Mr. John Hawkshaw, F.R.S., F.G.S. Local Secretaries for the meeting at Bradford—the Rev. J. R. Campbell, D.D.; Mr. R. Goddard; Mr. Pele Thompson, Local Treasurer for the meeting at Bradford—Mr. Alfred Harris, jun. General Secretaries—Captain Douglas Galton, C.B., R.E., F.R.S., F.G.S.; Dr. Michael Foster, F.R.S., Trinity College, Cambridge. Assistant General Secretary—Mr. George Griffiths, M.A. General Treasurer—William Spottiswoode, M.A., LL.D., F.R.S., F.R.G.S. Auditors—Mr. John Ball, F.R.S.; Mr. J. Gwyn Jeffreys, F.R.S.; Colonel Lane Fox, F.G.S. The sections are the following:—A. Mathematical and Physical Science.—President—Prof. Henry J. Stephen Smith, LL.D., F.R.S. Vice-Presidents—Prof. Balfour Stuart and Prof. Henrici, Secretaries—Prof. W. K. Clifford, M.A.; J. W. L. Glaisher; Prof. A. S. Herschell; and Prof. Forbes. B. Chemical Science.—President—Dr. W. J. Russell, F.R.S. Vice-Presidents—Prof. Roscoe and I. Lowthian Bell. Secretaries—W. Chandler Roberts, F.C.S.; Dr. Armstrong; and Prof. Thorpe. C. Geology.—President—Prof. Phillips, D.C.L. Vice-President—W. Pengelly, Secretaries—Louis C. Miall; William Topley, F.G.S.; R. Tiddeman. D. Biology.—Vice-Presidents—Dr. Beddoe and Prof. Rutherford, M.D. Department of Zoology and

Botany. Secretaries—Prof. Thielson-Dyer and Prof. Lawson. Department of Anatomy and Physiology. Secretaries—E. Ray Lankester and Dr. Pye-Smith. Department of Anthropology. Secretaries—F. W. Rudler, F.G.S., and J. H. Lamprey. E. Geography. President—Sir Rutherford Alcock. Vice-Presidents—Major-Gen. Sir Henry Rawlinson and John Ball. Secretaries—H. W. Bates, F.L.S., F.R.G.S.; Keith Johnston, F.R.G.S.; and Clements R. Markham, C.B. F. Economic Science and Statistics.—President—Mr. W. E. Forster, M.P. Vice-Presidents—Dr. Farr; Lord Houghton, D.C.L.; E. Baines, M.P. Secretary—J. G. Fitch, M.A. G. Mechanical Science.—President—W. Froude, L.L.D. Vice-President—A. Bessemer. Secretaries—H. M. Brunel; J. N. Shoolbred; H. Bauerman.

Quekett Microscopical Club.—The eighth annual general meeting was held on Friday evening last, July 25, at University College, Gower Street; Dr. Braithwaite, F.L.S., F.R.M.S., President, in the chair. The report of the Committee for the past year was read, and testified to the continued prosperity of the Club, which now numbers 570 members. The President delivered the annual address, in the course of which he noticed the progress of microscopical investigation in Botany and Zoology. The ballot then took place for the election of officers. Dr. Braithwaite was re-elected President; Dr. Matthews, Messrs. B. T. Lowe, T. W. Burr, and C. F. White, Vice-Presidents; and Messrs. Bywater, Crisp, Hailes, Hind, Waller, and T. C. White, were elected to fill the six vacancies on the Committee, and Mr. J. E. Ingpen succeeded Mr. T. C. White, who retires from the office of Honorary Secretary, owing to the increase of his professional duties, after four years of unremitting and valuable service. The proceedings terminated with the usual conversation.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

An improved method of carbonising clay, plaster, chert, porous stones, and other like porous materials. George Hard Smith, 3, Southampton Buildings, London, December 24, 1872.—No. 3915. My invention relates to a novel treatment of porous materials and articles or objects made thereof, whereby they are converted into materials possessing properties altogether different to those peculiar to them in their normal condition. My said invention consists in a process of treating such absorbent materials by first causing them to absorb carbon from a liquid containing the same, and then expelling the volatile portions of the carbon; and the said invention is applicable to the treatment of all substances capable of absorbing and retaining the carbon.

Improvements in utilizing waste products of chemical and other works, in order to render the same applicable for building and structural purposes. William McAdam, Glasgow, Lanark, N.B. December 27, 1872.—No. 3924. The feature of novelty which constitutes this invention is the utilising of the waste products of soda-ash works, kelp, ash, soap, iron, and other chemical works, and converting the same into bricks or blocks of solid material suitable for building and other structural purposes.

Improvements in distilling, evaporating, or concentrating saccharine and other solutions or liquids. David Crawford Miller, bleacher, Larkhall, Lanark, N.B. December 27, 1872.—No. 3926. The feature of novelty constituting this invention is the causing air or vapours or gases to pass into and through the solutions or liquids to be distilled, evaporated, or concentrated.

Improvements in and apparatus for extinguishing fire. William Lattimer, manufacturer, Holme Head, near Carlisle, Cumberland. December 27, 1872.—No. 3927. The invention consists in storing or preserving the chemical ingredients, when combined, produce a carbonic acid gas or other vapours for extinguishing fire, in two or more separate vessels or compartments provided with connecting pipes, instead of combining these ingredients as now customary in the case of the "fire extinguisher." The ingredients, being kept separate until they flow from their separate vessels and unite in the delivery pipe, produce the maximum effect.

Improvements in treating liquids to be burned for illuminating purposes. Benjamin White, chemist, and Patrick B. Thomas, Henry's commission merchant, Glasgow, Lanark, N.B. (A communication from Joseph Hale, jun., Cincinnati, United States). December 27, 1872.—No. 3930. The invention consists in taking naphthalene of a specific gravity of about 60° or 65° Baume, and mixing every 40 gallons of it with 4 lbs. pulverised alum, 5 ozs. camphor, 1 lb. starch (by preference that obtained from potatoes), and 4 ozs. oil of sassafras. The mixture is kept for two or three days, and well stirred at intervals, after which the liquid part is separated by filtration, and is then ready for use.

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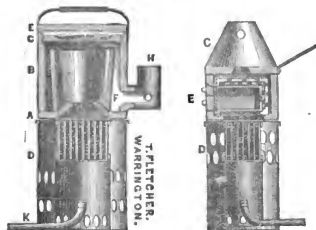
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THE CHEMICAL NEWS.

VOL. XXVIII. No. 715.

ON THE QUANTITATIVE ESTIMATION OF CHROMIUM, AND THE SEPARATION OF CHROMIUM FROM URANIUM.*

By WOLCOTT GIBBS, M.D.

THE quantitative separation of chromium from uranium appears not to have specially attracted the attention of chemists. No method is given either by Rose or by Fresenius. The two metals rarely, if ever, occur associated in the mineral kingdom, and the only definite artificially prepared compound which I have been able to find noticed is the uranic chromate described by Jahn, who does not appear to have analysed the salt, though Berzelius—judging probably from the mode of formation—attributes to it a formula which we should now write $U_2O_3 \cdot CrO_4$. Berzelius also states that neutral potassic chromate gives, with uranic chloride, a yellowish brown precipitate, which contains both oxides of uranium, as well as chromic oxide and acid. This compound also appears not to have been analysed.

As the method of separating the two metals to which I finally arrived involves the presence of the chromium as chromic acid, I began my investigation by examining the commonly received methods of estimating this substance.

Rose strongly recommends the method of Berzelius, which consists in precipitating the chromic acid by mercurous nitrate, and washing with a dilute solution of the same salt. The precipitated chromate is voluminous, and has a brown-red colour when the precipitation takes place in the cold. I find that a better result is obtained by precipitating at a boiling heat, when the mercurous chromate almost immediately becomes highly crystalline, its colour changing to a bright scarlet. It may then be washed with the greatest ease, and ignited in the usual manner. It is absolutely necessary, in applying this method, that the mercurous nitrate used should be perfectly free from nitrous acid. Want of attention to this point led me formerly into an error, which I desire to correct in this place. I have stated in a former paper that hot solutions must not be employed, on account of the reduction of chromic acid by mercurous nitrate. This reduction is not due to the temperature, but to the presence of a small quantity of nitrous acid in the mercurous nitrate employed. It is easy to avoid this source of error by dissolving the mercury in nitric acid in an open vessel, and crystallising the nitrate two or three times, using for solution dilute nitric acid which has been perfectly freed from nitrous acid by a current of air or carbonic dioxide.

To test the method thoroughly, the following analyses were made with pure potassic dichromate:—

I. Salt precipitated at a boiling heat by mercurous nitrate, and washed with hot water alone.

1. 0.6003 gr. gave 0.3030 gr. $Cr_2O_3 = 50.47$ p.c. Cr_2O_7 .

2. 0.4741 " " 0.2407 " " = 50.77 "

The formula $K_2Cr_2O_7$ requires 51.73 per cent if we take $Cr = 52.2$.

II. Salt precipitated cold by mercurous nitrate, and washed with cold water only.

3. 0.2641 gr. gave 0.1344 gr. $Cr_2O_3 = 50.89$ p.c. Cr_2O_7 .

4. 0.3098 " " 0.2607 " " = 51.13 "

III. Salt precipitated cold, then boiled, and washed with boiling water only.

5. 0.4957 gr. gave 0.2503 gr. $Cr_2O_3 = 50.49$ p.c. Cr_2O_7 .

6. 0.3193 " " 0.2388 " " = 51.43 "

IV. Salt precipitated cold, then boiled, and washed with hot water containing mercurous nitrate.

7. 0.4951 gr. gave 0.2558 gr. $Cr_2O_3 = 51.67$.

8. 0.3639 " " 0.1881 " " = 51.69.

In these last analyses the error of the mean is only 0.04 per cent. We arrive, however, more quickly at our object when we precipitate at once at the boiling-point, and then wash with a hot dilute solution of the nitrate.

In several works on analytical chemistry it is recommended to precipitate chromic acid from its solutions by plumbic acetate, and to weigh the resulting chromate of lead. In repeated trials I have never been able by any artifice whatever to prevent the precipitated plumbic chromate from passing more or less through the filter so as to render the filtrate turbid.

Precipitation of chromic acid by a baric salt was next examined. Potassic dichromate was precipitated by baric acetate, with the following variations:—

I. Salt precipitated by baric acetate at a boiling heat, and washed with water only; chromate weighed upon a porous earthenware filter.

1. 0.4617 gr. gave 0.7894 gr. $BaCrO_4 = 51.41$ per cent.

2. 0.4685 " " 0.8022 " " = 51.52 "

II. Salt precipitated by baric acetate at a boiling heat, alcohol added, and the precipitate washed with a hot mixture of 3 parts of water and 1 part of alcohol of 90 per cent, and ignited.

3. 0.3802 gr. gave 0.6546 gr. $BaCrO_4 = 51.78$ per cent.

4. 0.5282 " " 0.9069 " " = 51.66 "

III. Salt precipitated by baric acetate without alcohol. Solution after precipitation evaporated to dryness upon a water-bath, then washed with hot water and ignited.

5. 0.5366 gr. gave 0.9229 gr. $BaCrO_4 = 51.75$ per cent.

6. 0.5355 " " 0.9204 " " = 51.71 "

In the last analysis alcohol was added to the wash-water. From this it appears that very accurate results may be obtained by precipitation with baric acetate at a boiling heat, adding a small quantity of strong alcohol to the liquid, washing with water containing alcohol, and igniting. The wash-water need not contain more than 1/12th of its volume of alcohol. The precipitated chromate must, before filtering, be allowed to settle completely, leaving the supernatant liquid perfectly clear. The filtrate never becomes turbid, even after all the soluble salts are washed out. Finally, it is not necessary to weigh the baric chromate upon a weighed filter. A very small quantity of the chromic acid is always reduced by the carbon of the filter in igniting, but the loss of weight is inappreciable. This method is much shorter than that which is usually employed, as the filtration and washing may be executed almost immediately after precipitation.

The conditions necessary for the complete precipitation of chromic acid, either as mercurous or baric chromate, having been thus carefully reviewed, I next proceeded to attempt the quantitative separation of uranium and chromium. In a first series of experiments, weighed quantities of potassic dichromate were mixed with much larger, but undetermined, quantities of uranic nitrate. The chromic acid was then precipitated by mercurous nitrate from the boiling solutions. In this manner the following results were obtained:—

Gr. Gr.
1. 0.4120 $K_2Cr_2O_7$ gave 0.2130 $Cr_2O_3 = 51.74$ p.c. Cr_2O_7 .

2. 0.3292 " " 0.1702 " " = 51.70 "

3. 0.4543 " " 0.2353 " " = 51.77 "

The mean of these analyses is 51.73 per cent, which is precisely the percentage required by the formula $K_2Cr_2O_7$ ($Cr = 52.2$).

These analyses show that mercurous nitrate gives very accurate results. The employment of this salt in separating chromium from uranium is indicated only in those cases in which the chromium exists as chromic acid, in

* From the *American Journal of Science and Arts*, vol. v., Feb., 1873.
† *Am. Journ. Sci.* [II.], vol. XXIII., p. 59.

which relatively small quantities of chlorine or sulphuric acid are present, and in which no other acid is present which, like phosphoric acid, gives an insoluble mercurous salt not completely volatilised by ignition. In the presence of chlorine, sulphuric acid, &c., the following process may be very advantageously employed. The solution is to be boiled for a few minutes with a small excess of sodic hydrate, the precipitate of sodic uranate filtered off and washed with hot water containing a little sodic hydrate until the washings no longer give any turbidity, with a solution of mercurous nitrate. The sodic uranate in the filter is then to be dissolved in chlorhydric acid, and the uranium determined in the usual manner. The filtrate contains all the chromium as CrO_3Na_2 . After adding chlorhydric acid in excess, the chromic acid may be most conveniently reduced to chromic oxide by adding a solution of potassic or sodic nitrite and boiling for a few minutes, after which the oxide may be precipitated by ammonia in the usual manner. An alkaline nitrite is a better reducing agent than alcohol, as the chromic oxide may be precipitated immediately after the reduction.

It remains to consider the case in which chromic and uranic oxides occur together in solution. A solution of sodic hydrate in small excess is to be added, and the whole heated to boiling. To the hot liquid bromine-water is to be added. Chromic oxide is almost instantly oxidised to chromic acid, which remains in solution as CrO_3Na_2 , while uranate of soda with a small percentage of uranic chromate remains undissolved. After washing with hot water containing a little sodic hydrate, the precipitate, which has a deep orange colour, is to be dissolved in hot nitric acid, the solution boiled for a few minutes, to expel any traces of nitrous acid, mercurous nitrate added, and the whole allowed to stand until the small quantity of mercurous chromate has settled. This, after washing, may be ignited in the same crucible with the chromic oxide obtained as above from the sodic chromate in the filtrate. The filtrate is free from uranium. Repeated attempts to determine uranium by precipitation with sodic phosphate, and final weighing as uranic pyrophosphate, have led as yet to no satisfactory results. It is, however, worth noting that the gelatinous phosphate becomes pulverulent, and easily washed by simple evaporation to dryness.

THE MANIPULATION OF HYDRIC SULPHIDE.*

By JOSIAH P. COOKE, Jun.

THE manipulation of hydric sulphide in a large laboratory has always been a difficult problem, and the inconveniences arising from the use of this reagent in the state of gas are so great that, when a class of forty or fifty students are working with it at once, the nuisance becomes almost unbearable. When dissolved in water, however, this reagent gives as little trouble or annoyance as any other; but, as ordinarily prepared, the solution is so weak that the substance under examination is deluged with water before the required excess of the reagent has been added. This objection can be wholly overcome by dissolving the gas under pressure, and drawing off the solution from a syphon like soda-water, and in any laboratory where water is supplied under pressure such a super-saturated solution can be very readily prepared with a very simple apparatus, which may be mounted in the following manner:—

We use for the purpose the common green glass bottles in which acids are usually sold by the druggists, only taking care to select strong bottles with a well rounded neck about 1½ inches in diameter. Let us designate by A, B, and C three 2-quart bottles of this description, and by D a similar, but larger, bottle, having a capacity of 2 gallons. In A the gas is generated from ferrous sulphide, water, and sulphuric acid, in the ordinary way.

* Communicated by the Author.

We pass the gas from A, first through a wash-bottle filled with moistened sponge, and then through the distilled water with which the bottles B and C are about three-fourths filled, the gas bubbling up as usual from glass tubes leading to the bottom of each bottle, and the excess not absorbed by the water passing forward to the large bottle, C, which serves as a gasometer. All these bottles are fitted as tightly as possible with rubber stoppers, through which pass the stout glass tubes that conduct the gas. Through the stopper of D pass three such tubes: the first, which brings the unabsorbed gas from C, opens at the top of the bottle; the second is connected by a rubber hose with a water faucet, and reaches to the bottom of the bottle; the third serves simply as a vent. The bottles B and C are fitted each with two tubes, one to deliver the gas at the bottom of the bottle, and the second, opening from the top, to conduct away the excess. The gas generator, A, requires only an exit tube; and, lastly, the wash-bottle is fitted in the ordinary way, save only that we pack it with well-washed sponge, by which the gas is more effectually purified than when it bubbles through a liquid. We use glass tubes of about 3/16ths of an inch bore, and rubber hose of the same calibre, but very stout and made of pure vulcanised rubber. The rubber stoppers are cut from what we call *stopper cord*, which, as well as the hose, is made by the Boston Belting Company. In mounting the apparatus, we interpose 2 or 3 feet of hose between the several parts, so as to have sufficient freedom of motion to enable us to shake up the water with the gas in the bottles B and C. Over the ends of the tubes from each of the bottles B and C we stretch permanently two rubber connectors, cut from the hose just described, and depend wholly on *pressure-taps*, acting on these connectors, for closing the bottles. While charging the water with gas, the connectors are united to the hose by short lengths of glass tube, and subsequently the solution is drawn off through a bent glass tube slipped into one of the same connectors. The bottles, thus arranged, serve the same purpose as a soda-water syphon. The rubber stoppers soon become cemented to the glass, and are never removed, the bottles being filled as they are vented, through the glass tubes. A rubber connector with a pressure-tap must also be provided for the vent-tube of the large bottle, C, which serves, as we have said, to receive the unabsorbed gas. In charging the water, we leave the vent of this gasometer open until the air is expelled from the apparatus, and then connect the vent-tube by a rubber-hose with a manometer, which, if a common steam manometer is not at hand, can be easily extemporised with a glass tube and a little mercury. We now watch the pressure, and when it becomes equal to the water pressure on our faucet, we turn on the water head. On first opening the faucet it is necessary to watch the process very closely, lest the water should be forced back into the generator, but the apparatus soon adjusts itself to the new conditions, and the absorption goes on as regularly as before. The unabsorbed gas is, of course, stored in the bottle C, and gradually pushes back the water, with which at first it is three-fourths filled, into the supply pipe; but only a small portion of the gas is lost, and, with the apparatus of the dimensions described, a 2-gallon bottle is large enough to hold all the excess, which escapes before the water is saturated. To ensure perfect saturation, the water in each of the bottles B and C should be frequently shaken up with the gas, especially towards the end of the process.

We constantly use an apparatus mounted as above, with a water-head of about 30 feet. It would undoubtedly stand a much greater pressure, but a solution saturated under a pressure of two atmospheres is as strong as is desirable. For example, 100 c.c. of such a solution is more than sufficient to precipitate a gramme of antimony. For saturating 4 litres of water in an apparatus of the dimensions described above, the charge should be about 200 grms. of ferrous sulphide, about 2 litres of water, and 288 grms., or 160 c.c., of sulphuric acid. At this amount

of acid water, when at a low temperature, is insufficient to dissolve all the ferrous sulphate formed. We place the generator in front of a hot air register. In dismounting the apparatus, we close first the inlet-tube of the bottle B, and then remove the generator and wash-bottle; but care must be taken to relieve the pressure on the generator very slowly, otherwise the escaping gas will cause the acid solution of ferrous sulphate left in the bottle to boil over.

By the use of a solution of hydric sulphide in place of the gas, the consumption of ferrous sulphide in our large laboratory has been reduced twentyfold, and when it is remembered that by the previous waste the air of the room was constantly poisoned, and the waste-pipes clogged with the undissolved sulphide of iron, carelessly washed into the sinks, the advantage will be appreciated. The gain in those processes of quantitative analysis where hydric sulphide is required is hardly less important. The bubbling of a gas through a liquid inevitably entails loss, which can be wholly avoided by using the solution, and, by regulating the pressure on the tap, the reagent can be delivered in the proportions required, and at the exact point where it is wanted. Complete precipitation, moreover, is effected in a few minutes; and, if the liquid is constantly stirred as the reagent slowly flows in, the precipitate will settle in a condition admirably adapted for filtering. Lastly, the separation of sulphur, which is often so excessive when the gas is employed, is diminished, if not prevented, by using the reagent in solution.

THE INTERNATIONAL EXHIBITION OF 1873.

CHEMISTRY may be said either to be or not to be represented in this year's Exhibition. The products of chemistry considered as a pure science would not, perhaps, afford more pleasure nor profit to the visitor than could be obtained from a call upon his druggist. Stopped bottles, however brilliant their contents, have very much in common; but chemistry as an applied science appears under some one or other phase in nearly every process of manufacture, and the products and processes of this year's Exhibition are consequently as interesting to the technical chemist as the exhibits of years when chemistry has been expressly included.

The products of this year are chiefly related to Food—one of the most important, if not the most important, of the applications of chemical science. For much as chemistry has done for our tables and ourselves, there still remains for it to solve the problem of the proper preservation of food. Until it has solved the problem we may never hope to see in any exhibition anything better than artificial representations of the three great staple foods—meat, vegetables, and bread. For the reason that the question is yet to be fully solved, we have in this year's Exhibition a predominance of groceries and dry-saltries. But these, although most important exhibits, have not the scientific nor utilitarian interest attaching to the preservation of flesh. Doubtless, without tea, cocoa, coffee, biscuits, confectionery, we should be badly off indeed, but it is possible to imagine existence as progressing in their absence. Flesh, however, is so universal a staple food, that without it existence to many of us would be not only a hardship, but probably impossible. Yet so rapidly does the price of fresh meat increase that daily the desideratum of providing some efficient means for its proper preservation becomes more pressing. Men have long recognised the importance of the question. As early as 1690 Messrs. John White and William Porter obtained from the Crown a right of monopoly for fourteen years in the preservation of flesh; and from that time to this many hundred patents have been taken out, the processes meeting with more or less success. Until this time the methods of preservation may be classed under four heads:—(1) Preservation by cold; (2) by drying;

(3) by removal of air; (4) and by the use of chemical antiseptics.

Preservation by cold is a naturally established fact. In the Arctic regions, Russia, and Canada slaughtered animals are buried for months in the frozen earth and ice. Our fishmongers use ice as the chief preservative of their fish, either in over-night stock, or its progress to and from market. And it has been proposed to import from South America, Australia, and elsewhere, where meat is cheap, carcasses of animals preserved in ice. Actually among the exhibits of this year there is only one of preservation by cold shown by the Atmospheric Churn Company; who, in one of their refrigerators, have some butter, fish, and a joint of meat. Messrs. Chevasse and Co. also exhibit one of their "Clifton's Patent Dry Cold-Air Refrigerators," containing the ice-chamber at the back, and feeding the food-chamber with cold air by means of valves, these valves being opened by a rod when the door is closed, and *vice versa*. External air is thus prevented entering the ice-chamber in any bulk when the doors are opened. The Piston Freezing Machine and Ice Company exhibit several of Ash's patents, the chief being the Self-Feeding Cabinet Refrigerator, arranged in such manner that the lowest temperature is available until the complete expenditure of the ice. The ice-chamber is inclined at an angle to the side of the safe, so that as the ice melts it still bears with nearly the same surface against the food-chamber. Messrs. Howe and Shoppee exhibit an "Arctic Ice Safe" lined throughout with non-conducting white glazed porcelain tiles, having the advantage of being readily cleansed. Messrs. Kent have on view one of their "Ventilated Ice Safes," constructed on the principle that cold air being heavier displaces warmer air and descends. It is stated that in such a safe mutton may be kept for a fortnight at a temperature of 40° to 45°, and a sweetbread—one of the most difficult things to keep—for a week. Cream also has been preserved for a week. Messrs. Brainard have a model of their patent ice-house, largely employed in America; and there is a very interesting model of the ice-room of the Peninsular and Oriental Company's steamship *Cathay*.

Probably the most ancient process of flesh preservation is by drying. The Egyptians preserved birds or poultry in this manner, and the American Indians have long been adepts at the preparation of "charqui" or dried beef, the "damper" of the Australian squatter. But of this kind of preservation one does not see examples at South Kensington this year, except in the preservation of peas and vegetables together with dried and powdered meat in the form of biscuits, the chief exhibits being by Messrs. Whitehead, Messrs. Geyelin, Messrs. Warriner, Messrs. Hewetson and Co. The Prussians during the late war gave much attention to this mode of preservation, and their "Ebswurst" or portable soup is exhibited by Messrs. Johnston, who have also some meat powders. Messrs. Gillon show some dried and compressed vegetables with dried beef.

Preservation by expulsion of air is daily becoming more familiar to us, whether in the case of milk, meat, soup, or fish. This method is probably the most perfect we have, as it preserves flavour and moisture, and presents the food in a cooked form—a great benefit to the working classes. The meat, fish, or whatever is to be preserved is put into the tin in which it is to be kept, a small pin-hole being left. The tins are then immersed in chloride of calcium baths, or salt-water baths, or by other means raised to a higher temperature than the boiling-point, and the air thus expelled. From the preserving market of Aberdeen we have the greatest show of food preserved in this manner, the chief exhibitors being Messrs. Moir and Sons, who since 1822 have devoted their attention to the subject. This firm preserves as much as two-and-a-half million pounds of meat in a year, forming but a moiety of the nearly five million pounds of food put up yearly by them into tins. Messrs. Hogarth also exhibit fish and soups preserved in a similar manner in glass jars.

Messrs. Whitehead have their Australian beef and mutton and solid essences. The Ramornie Company, the first association for the sale of Australian meat, exhibit preserved Australian muck-turtle, rump-steaks, ox-tongues, beef-stew, &c., Messrs. McCall and Co. exhibit meat from Uruguay, some kangaroo-tail soup, and, indeed, kangaroo *a la mode*, and in every other mode. This firm also exhibits dried turtle for the making of real turtle soup. Messrs. Gillon, who have employed since 1817 a large number of hands in the preservation of meat, exhibit specimens of the essence of beef, condensed mutton, and chicken juices, Scotch broth, cockie-leekie, haggis, and other preserved dishes in which a Scotchman doth most delight. Then we have the Ballarat Meat Preserving Company; and, dear to the heart of Anglo-Indians, the preserved curries from Mr. Halford—chief to a former Governor-General of India. Two fowls here, preserved in tins, can be bought for seven and sixpence. The Food Preserving Company (late Forbes and Co.) exhibit results of Jones's patent process. In this process a vacuum apparatus is employed to withdraw the air from the tins, and by this means much of the over-cooking arising from the expelling process is avoided. A model of the apparatus is shown. Mr. Tallerman, of the Australian Meat Preserving Agency, has in the western annexe some meat actually in process of preservation on the chloride of calcium baths, and considerable exhibits of Australian veal and lamb. Of condensed milk, by the process which is now so well known to the public, there are exhibits by the Aylesbury Company, who also show coffee and cocoa combined with milk.

The preservation of meat by antiseptic processes is not illustrated in this year's Exhibition, unless we include the use of salt as an antiseptic. Chemistry does not appear to have solved the problem of preservation by means of a tasteless, innocuous agent; for of most processes hitherto known, even after much washing of the meat, there is considerable danger of the occurrence of disagreeable flavour.

Passing from Food to Confectionery we find many interesting illustrations of machinery and processes. Walking down the machinery transept the visitor's attention is attracted by immense revolving bulged-in copper vessels, in which he find almonds and caraway seeds are in course of conversion into sugar-plums and comfits. These seeds are caused to roll over and over, and thus gradually collect a coating of the hot clarified sugar which is added to them from time to time. When a moderately thick coating of sugar has been imparted another coating is given, and when of the desired size the colouring matter is poured into the pan. The exhibits under this head are by Messrs. Allen, and by Messrs. Hill and Jones. A little further on will be found an exhibit by Messrs. Batty illustrating the method of preparing oranges for marmalade: a disintegrating flour mill by Messrs. Carr and Cunningham; and apparatus for cutting and moulding sweetened gum into jujubes by Messrs. L. Collier. Messrs. Coleman exhibit the apparatus employed in separating mustard from the seed; and the Compagnie Francaise, machinery used in the preparation of cocoa. Messrs. Criscuolo, Kay, and Co's machinery for the preparation of macaroni naturally is an object of interest to the visitor. It is stated that the Italian wheat from which the macaroni is prepared contains on the average 15 per cent flour, 24 per cent bran, 16, 3, and 42 per cent respectively of semolina of second, first, and superfine qualities. An ingenious method of sifting and cleaning wheat is shown by Messrs. J. N. Sears and Co. The principle consists in causing the grains to meet a blast of air by which the refuse is removed, and the heavier grain allowed to descend into the hopper.

Leaving for a time the machinery annexe we enter the Australian Court. Here the chemist will be much interested in the specimens of mineral wealth of our colonies. There are exhibits of gold imbedded in quartz, and a superb lump of malachite. The specimens of copper ore

from the Moonta mine are remarkably fine, and we understand that 18,000 tons of such ore is yielded yearly. The greater part of the ore is yellow sulphide, but there are specimens of quartz and purple sulphide ranging as high as 50 per cent, with peacock ore (copper pyrites) at 30 per cent. There are chlorides at 45 per cent; and some rare specimens of black and crystallised oxide, together with some grey sulphide, attain to 75 per cent. The Wallaroo mine sends specimens of green copper carbonate; and the Mount Ballannah mines exhibit specimens of bismuth. Kauri gum is also an interesting exhibit. This gum is obtained from swamps formerly covered by Kauri trees by seeping the ground until gum exudes. It is then dug out, and forwarded to the hands of the varnish maker.

The Victorian annexe contains further exhibits of Australian preserved food, hams and bacon, tinned meat, &c., and a very valuable attempt to preserve fresh uncooked meat in an ice-room. It is stated that a vessel under the care of Mr. Harrison, the inventor, is on her voyage to England with 100 tons of meat thus preserved on board.

In the Russian annexe, too, there are exhibits of tablets of dry meat and game prepared by M. Wladislas Kleczkowski, Messrs. Kittarg's packets of dried vegetables, dried mushrooms on strings, dried green peas, &c.

As a journal of physical and applied science, our report would not be complete without some mention of the machinery in the annexe we have already visited. A process comparatively strange to this country is to be seen in progress at the stall of Messrs. A. Jouffray, the winding of silk from the cocoon of the silkworm. The apparatus consists of a brass-topped table in which are inserted shallow turned boilers, the water in these boilers being heated by jets of steam. The operator, having thrown the cocoons into this boiling water, provides himself with a whisk-brush, and plunging this into the bath, collects on its fibres the filaments of the cocoons floating on the surface of the water. These filaments he then passes to a glass eye, whence it is carried to a reel turned by power. Then we come again to specimens of English manufacture, for the winding machines are from the hands of Messrs. Rushton, Son, and Co., of Macclesfield. From the "winder" the silk passes to the cleaning machine, which consists of two fixed plates, and between these the fibre is passed to detect knots and other irregularities. Next the fibre appears upon the doubling machine, where two or three fibres are run together side by side without twist, the result being termed "train." If the fibres are to be twisted they are taken to the fourth or spinning machine; the twist fibre given out by this machine being known as "gramme." Near at hand there are similar machines by Messrs. Higginbotham, and a machine for recovering silk waste by Messrs. Greenwood and Bailey. The Jacquard and other looms shown by Messrs. Warner, Sillet, and Ram, Messrs. Norris and Co., and by Messrs. Stevens we need not here dwell upon.

Objects well worthy attention are the ingenious devices for the production of aerated waters and for bottling the same exhibited by Messrs. Fleet and Co., Messrs. Hayward, Tyler, and Co., and by Messrs. Barnett and Foster. In these new methods of bottling advantage is taken of the expansive force exerted by the compressed gas, which is caused to hold a glass marble or wooden plug against a welt of india-rubber inserted in the neck of the bottle.

In the stoneware department we have an elegant piece of design by Messrs. Doulton and Co., whose collection of chemical apparatus was so noticeable last year. And, though very distantly allied, we have the apparatus for boring rock and stone exhibited by the Diamond Rock Boring Company, who show a "drill head" and "prospecting machine." Hard black diamonds are fitted into a collar, and the drill thus constructed is caused to rotate against the face of the rock as in other boring machines. But far the most philosophical instrument for working in stone is the sand-blast of Mr. Tilghman. The principle

of the apparatus is that a blast of air or steam is caused to carry a jet of sand against the surface to be abraded. A description of the apparatus has already appeared in these pages; and it will be necessary only to say that with a pressure of 55 lbs. 3-16ths of an inch of marble can be cut away in five minutes, and glass almost instantaneously engraved, a design cut in paper being first placed on the portion to be protected.

The department devoted to surgical instruments will be one of the greatest interest to the professional medical man, but to the general reader the instruments cannot well be described. The "Pneumatic Aspirator," for removing morbid fluids from a natural cavity, is perhaps one of the most recent improvements in medical appliances. It consists of an exhausting syringe of about 4 ozs. capacity, with an airtight piston. The nozzle is bent at right angles, and is provided with two stopcocks. A hollow needle is affixed to the nozzle, and the piston being raised and the air exhausted from the instrument, the needle is introduced into the tumour. When a sufficient depth has been reached to prevent access of air the stopcock is turned, and the fluid by atmospheric pressure is drawn into the aspirator. The aspirator filled, the stopcock is closed, and the second cock opened; the piston is pressed down, the fluid discharged, the cock closed, the piston re-drawn, and the operation if necessary may be repeated.

Returning to the galleries of the Albert Hall, we find several inventions relating to railway signalling; which, however, we cannot efficiently describe without drawings. In one corner of this room are the Magneto-Electric Clocks exhibited by the British Telegraph Manufactory. The principle of these clocks is that of an unbroken circuit, which includes a coil of wire attached to the pendulum of the motor clock (and vibrating over permanent magnets) and the coil of the secondary clock. At each vibration of the pendulum coil of the motor clock an induced current is generated, which is transmitted to the secondary clock, where it actuates a set of rotating magnetic needles. A system of these clocks have been presented to the Royal Institution; and a set has been for some time working at the University of London, Burlington Gardens.

From a practical point of view the Exhibition of this year, attended as it will be, and is, by those really interested in its exhibits, shows elements of great success. This year we lose much that has been striking in former Exhibitions, but the gain in practical instruction, and as a record of real progress, is much enhanced. The Commissioners are certainly to be congratulated on the success of the year.

ON THE ENERGIES OF THE IMPONDERABLES, WITH ESPECIAL REFERENCE TO THE MEASUREMENT AND UTILISATION OF THEM.*

By the Rev. ARTHUR RIGG, M.A.

(Continued from p. 56).

MR. MICHAEL suggested to Cavendish an experiment which has ever since gone by the name of Cavendish's experiment, and from which was deduced the first pretty accurate calculation or actual measurement of the density of the earth. Cavendish, as you know, was a very wise man. It is said of him that "he was the richest wise man, and the wisest rich man, that the world ever saw." He left more than a million of money. He had also another quality which would be very desirable to cultivate in certain parts of this kingdom at the present time—he uttered fewer words than any other man who attained the same age is supposed to have done. He discovered many things, and, amongst others, he was the first to make an attempt

at weighing the whole earth, and he weighed it with an accuracy which has only been confirmed in recent times.

The apparatus that Cavendish used was double the size of this which you see before you, but it was similar in construction. He had two balls of lead, similar to these large ones, suspended from a very light bar, that bar being trussed, as it is called, by a kind of triangle of wires, and the whole being attached to a hook in a pulley, round which he passed a cord, by means of which the balls of lead can be moved to any position you please. In order to exclude every external influence, the apparatus was enclosed in a room of its own, and to observe the phenomena that took place within that closed room lamps were applied at small orifices, and telescopes were placed at others. In addition to this apparatus with the two balls of lead, which weighed about 3 cwt. each (as far as my memory serves), he had another apparatus placed below the other, as you see here. From a centre immediately under the pulley to which a frame carrying the leaden balls is attached, was suspended by an exceedingly fine wire a light rod with two little balls, less than bullets, and these balls held a certain position, and could not move from it beyond certain limits. Being placed in the aforesaid enclosed room, where there were no draughts or variations of temperature, or anything external to affect them, and they had been left for some time—say, for twenty-four hours, they became stationary, and would not move unless some external force were applied to them. At the end of the light bar carrying these small balls was an ivory scale and a pointer, and upon this was directed the light of a lamp from outside the room, whilst a knob was also placed outside, by turning which the motion of the large leaden balls could be controlled. At another orifice was placed a telescope, by means of which the motion of the pointer could be observed. After the little balls had become quite stationary, by the cord he very gently swung the larger balls to a position close to the small ones, and after a certain lapse of time, varying from a quarter of an hour to an hour, he observed the space through which the small balls were moved from the position they had occupied. It may be well to state that a thorough examination had been previously made as to whether any influence could be due to magnetism.

This experiment had to be repeated very frequently, because of the minuteness of the range of these balls and the magnification of it. The application of the results was to be so important. He therefore made three experiments on each occasion, and observed the position that the balls took. He also observed another matter, which is of great consequence, although this evening to be passed over very lightly, namely, the number of oscillations made by the small balls before they came to rest. These balls oscillate like a pendulum, and by the number of times they swing before coming to rest certain calculations of great importance to the inquiry may be made. These calculations being completed, the conclusion he arrived at was that the earth was $5\frac{1}{4}$ (say 51 times) heavier than water.

Now it is only right that you should be told how from these balls the density of the earth can be deduced. The mass or quantity of matter in these balls is known; their attraction upon the little balls is known from observation. The mass, therefore, of any other ball being known, we can tell the attraction that it would have upon these balls. It is quite clear that if this large ball had double the mass it would have double the attraction at the same distance; if treble the mass, treble the attraction, and so on. Again, if the mass of the little ball was known and the attraction of the great one known, and the mass of the great one known, then if the mass of another ball is known, we shall get the attraction of that other ball. It should also be attempted to make clear how, from these two balls, we can weigh the earth, and probably it will keep your interest alive in the matter if informed that, in 1835 (Cavendish's experiments being made at the close of the last century,

* The Cantor Lectures, delivered before the Society of Arts.

about 1798), Mr. Baily, the founder of the Astronomical Society, repeated them. Mr. Baily had been a stockbroker in London; he retired from business, and purchased a house in Tavistock Place, the one, I believe, in which Mr. Digby Wyatt now lives. He there made many experiments, and some most extraordinary calculations, and did a large amount of astronomical work. Amongst other things he undertook to weigh the earth, and he weighed it as Cavendish did, namely, by an apparatus constructed on the same principle as the one before you. He swathed the box or chamber, in which the balls were, with flannel, and put a gilded cover over all. He also lined the inside with tin-foil, and connected it by a copper wire with the earth. These precautions were intended to neutralise, as far as practicable, changes in atmospheric temperature and terrestrial electricity. How important he considered it you may judge from this, that he made more than 2500 experiments with balls of this character; he sat watching them for 1200 hours, and that number of experiments extended over some years. The repetition was planned in 1835, commenced in 1837, and concluded in 1842. The result of these 1200 hours of watching, exclusive of the calculations which followed, led to the conclusion that Cavendish was right within a fraction of 2-10ths, that is to say, Cavendish concluded that the density of the earth was 5.4 times that of water; Baily concluded that it might be 5.6 times that of water.

It may be permitted to repeat the reasoning, in order if possible to make clearer the principle on which it proceeds. From the weights we know the masses of the large ball and of the small one. We know that the small balls in relation to the large ones were free from the influence of gravity; we also know by observation how much the one attracts the other. Double the ball, and you get double the attraction, and so on. Now, we know the size of the earth, and by placing this little ball on a spring balance we know how much the earth will attract it. Therefore, the weight of the little ball being known, and the size of the earth being known, there is nothing left except the attraction to find, and, as we have the attraction from these two balls, we can, by a simple arithmetical operation, determine that the earth is 5.6 heavier than water.

This seems the best opportunity to name that the present Astronomer-Royal (Professor Airy) investigated by very different means, and on very different principles, this question of how much heavier than a globe of water the earth is. Qualifying the conclusions from his experiments as himself suggests, consequent upon certain geological considerations, it may be asserted that Cavendish's result is very nearly correct.

Time passed by; Cavendish's experiment was made, as I told you, about 1798, and Baily repeated it about 1835. We must now go back, as a matter of history, to Cavendish's time, and the next step we arrive at in determining the energy of gravity was the experiment that was made by Atwood, who was born in 1746. He was a Fellow of Trinity College, Cambridge, and was the first to entertain the idea of devising some plan of measuring the force of gravity. Let me endeavour to make this matter clear. Cavendish determined the density of the earth, but he did nothing whatever as to determining the force of gravity. Force, as stated in the first lecture, can only be measured by motion. We can easily obtain motion from the action of gravity, but we must observe that motion in order to measure force. If a weight be let fall, it falls far too quickly to permit of an estimate of the rate at which it falls. That rate is due to gravity. Atwood thought, as Galileo had previously done, that by causing the fall to be delayed, he might be able to draw a conclusion as to the exact force of gravity, and the plan he adopted was this. You are aware that the intervals between the ticks of a pendulum vary according to its length. Here is a pendulum, and you see the rate at which it is going;

if, now, the pendulum-weight be lowered, so as to lengthen the rod, you may observe that the pendulum ticks more slowly—in fact, it is now beating seconds. You were told, in the first lecture, that we must have a certain unit of measurement, and the second is the unit of measurement usually taken for time. If we want smaller measurements, for it is easy to divide the second into a hundred parts, they are taken by another contrivance. A very simple and efficient one is a clepsydra, or water-clock, arranged specially for this purpose.

What Atwood thought of doing in order to measure the force of gravity, having, you remember, no previous measurements to guide him (for Galileo did not touch the problem that Atwood proposed to solve), was to take two weights evenly balanced over pulleys such as these, the apparatus being most delicately made. You see that these two small weights are exactly balanced, one being at each end of a cord which passes over pulleys at the top of the apparatus, so that the weight in descending passes down in front of a graduated scale. These weights, then, are exactly balanced. Here are three very small weights, fractional parts of the ones which are suspended. If one of these small weights falls by itself, it would fall so rapidly that its rate of falling could not be observed; but if, whilst it is falling, it is caused to bring this mass of matter with it, the rate of falling will be retarded, whilst the law of the rate remains the same, i.e., the law which governs the rate of falling will be similar, although the mass moved is increased. If now there be placed upon one of these balanced weights two of these little fractional weights, there is a something that will cause the connected mass to move, and this platform at the bottom will be struck about four seconds after the motion commences. The usual plan is to let the motion be commenced by electricity, which at the same time sets the pendulum in motion. You can count the strokes of the pendulum from the commencement to the end of the motion. You can see this mass of matter has been moved through eighteen spaces in four seconds. If the measure be altered, you will readily understand that these fractional weights would carry it through a different space in the same time; if other weights be put on, they would carry it through other spaces. The experiment, as made before the apparatus was brought here, shows that the force of gravity is such as to cause a body to fall through about 32 feet in one second, the meaning being that if this small weight had not been required to bring the other weights along with it, then it would have fallen from rest through 32 feet in the first second. That was the first attempt of estimating by measurement the force of gravity.

But Atwood's apparatus, though exceedingly good as matter of illustration, falls very far short indeed of that which Captain Kater adopted; and all that we have, and all that we know, of the form of the earth, and the true kinetic measure of gravity, spring from Kater's experiments, and not from either Cavendish's, Baily's, or Atwood's. Kater felt that, if instead of weights falling as they have fallen in the experiments of Atwood, he could observe the effect of gravity upon the weight falling without associating it with other weights, if it could be kept quite distinct, and if in any way he could cause gravity to repeat the operation slowly and deliberately, without any interference whatever, we might get at the conclusion much more rapidly than Atwood could by his arrangement, because the friction of the wheels, the weight of the cord, and other incidental matters affect the problem. What Kater did was to design a pendulum, of which this is a copy. It was from a pendulum like this that not only was the force of gravity determined in all parts of England, but also the form of the earth itself has been decided and estimated. Our standards of weights and measures all come from a pendulum like this. If, in

ADULTERATION OF BUTTER.

To the Editor of the Chemical News.

fact, the standards were all lost, it would be from such a pendulum they must be restored. Let me anticipate the conclusion by stating that when the standards were lost in the burning of the houses of Parliament they were restored by seeking for copies, because the great number of corrections and the great difficulty of counting this pendulum and freeing it from interfering causes are very serious obstacles. Few are aware of the enormous difficulty there is in placing a pendulum so as to be free from external influences, and counting the oscillations of it.

Whilst upon weights and measures, your attention may be directed to a small piece of wood here, which is a model of the standard one pound weight of Great Britain. It is one which a committee of learned men obtained, and this in my hand is a copy. The real standard is made of platinum. It is a cylinder 1.35 inches high and 1.15 inches in diameter. Observe there is a groove turned in it, and there is an ivory fork by which it is to be lifted—these standards are not to be touched. There are only five of them made, and if ever the one pound weight is lost in England it is to be recovered, not by repeating Kater's experiments, but by copying one or other of these five standards. The five are kept—one at the Exchequer Chambers at Westminster, one at the Royal Mint, one with the Royal Society, one at the Royal Observatory, Greenwich, and one is immersed in the sill of the recess on the east side of the lower waiting-hall of the New Palace at Westminster.

(To be continued.)

CORRESPONDENCE.

ON THE ESTIMATION OF MAGNESIUM AS PYROPHOSPHATE.

To the Editor of the Chemical News.

SIR,—In your last issue I observed a paper, communicated by Dr. Gibbs, suggesting the substitution of ammonium-hydrogen-sodium phosphate, $\text{NH}_4\text{HNa}(\text{PO}_4)$ (micro-cosmic salt) for the ordinary sodium phosphate, as a precipitant for magnesium. Might I add a few remarks upon this subject? Some four or five months ago, at the suggestion of Dr. W. Ramsay, I undertook a series of experiments with a view to ascertain whether or not this mode of procedure would yield good results. In my first experiments I precipitated the magnesium from a cold solution of magnesium sulphate containing ammonium chloride, but failed in obtaining results which could be considered as satisfactory. In my subsequent experiments I heated the mixed solutions of magnesium sulphate and ammonium chloride to the boiling-point, and precipitated the magnesium from the boiling liquid by adding the $\text{NH}_4\text{HNa}(\text{PO}_4)$ solution. After having been allowed to cool, ammonium hydrate was added, and the whole allowed to stand for twenty-four hours. The precipitate of $\text{Mg}_2\text{NH}_4(\text{PO}_4)_2 \cdot 6\text{H}_2\text{O}$ was then collected upon a filter, dried at 100°C , ignited, and weighed as $\text{Mg}_2\text{P}_2\text{O}_7$ in the usual manner. The following figures will serve to illustrate the accuracy of this process:—

Grms.	Grm.	Grm.
1.0020 $\text{MgSO}_4 + 7\text{H}_2\text{O}$	= 0.4550 $\text{Mg}_2\text{P}_2\text{O}_7$	= 0.0985 $\text{Mg} = 9.85$ per cent.
1.0321 "	= 0.4675 "	" = 0.1011 " = 9.78 "
1.3850 "	= 0.6264 "	" = 0.1354 " = 9.79 "
1.0022 "	= 0.4561 "	" = 0.0986 " = 9.84 "

The mean results being 9.81 per cent. As $\text{MgSO}_4 + 7\text{H}_2\text{O}$, theoretically speaking, requires 97.76 per cent of Mg , this leaves an average error of about 0.04. As magnesium is a substance which analysts have frequent occasion to estimate, Dr. Gibbs's suggestions are well worthy of their consideration. For my part I can heartily recommend his process.—I am, &c.,

R. W. EMERSON McIVOR.

Glasgow, August 4, 1873.

SIR,—I am taking a lively interest in the discussion on the method of detecting the adulteration of butter, and am glad that Mr. Horsley has written to remind your readers of his previous work on the subject. I have found his process very useful and practical, and have used it to a considerable extent. A simple way of applying the ether method is the following, which I copy from an article on the "Detection of Adulteration of Butter," contributed by me to the *English Mechanic* during the autumn of last year:—

"Animal fats in butter are best detected by shaking a small portion of the sample with a moderate quantity of ether, in a corked tube, at the ordinary temperature, when the butter will readily dissolve, and leave the adulterating fat as a milky fluid at the bottom of the tube; the residue when due to lard is pretty fluid, but that left by tallow or dripping has a peculiar, thick, granular appearance. The upper liquid should be poured off, and the residue washed once or twice with a little cold ether, when it may be examined under the microscope, and tasted, after warming to get rid of adherent ether. If the test be made on a mixture of pure butter with lard, tallow, dripping, &c., a few trials will show that it is capable of giving very fair results. Excess of ether must be avoided, or complete solution will take place. If the butter contains much salt or water, it is best to purify it first by melting and shaking with hot water."

The success of the test evidently depends on the sparing solubility of stearin in cold ether. Dr. Campbell Brown's method is a more refined application of the same principle. The taste of the residuary fat is quite characteristic. Pure butter sometimes leaves a slight residue, but it is free from any taste of animal fat. Although the analyst employing the above test may possibly fail in detecting a small admixture of lard, he can scarcely miss dripping or tallow, 5 per cent of the latter fat being readily recognised by the method described. The test also furnishes unscientific persons with a convincing proof of the adulteration, a fact which is not without its value.

Of course, as above described, the test makes no pretension to scientific accuracy, but by the use of definite weights of butter and ether it forms a very valuable adjunct to (and in some cases a substitute for) the more elaborate methods recently proposed.—I am, &c.,

ALFRED H. ALLEN, F.C.S.

Borough Analyst's Laboratory, Sheffield,
August 5, 1873.

University of London.—The following is a list of the Candidates who have passed the recent B.Sc. Examination:—*First Division*.—Peter Phillips Bedson, Owens College; Edward Boyce Cumberland, private study; Thomas Frederick Harris, private study; Samuel Alexander Hill, Royal School of Mines; William Hudson, private study; John Viriamu Jones, University College; Oliver Joseph Lodge, private study; James Gordon MacGregor, Edinburgh University; William Rushton Parker, Caius College, Cambridge; Thomas Slater Tait, Owens College; Claude Metford Thompson, University College; Arthur Thomas Wilkinson, B.A., Wesleyan College, Taunton. *Second Division*.—William Brown, Birkbeck Institution; George Christopher, University College; George Simmonds Dunn, B.A., private study; John Gilliot Garbutt, M.A., St. Mary's Hospital; Charles Hopkinson, Owens College; Peter Horrocks, Owens College; John Neville Keynes, B.A., Pembroke, Cambridge, and University Colleges; William Henry Munns, B.A., University College; Frank Prior Purvis, private study; Prasanna Kumar Ray, University College; Charles Robinson, Owens College; Herbert Robson, University College; Alexander Simpson, B.A., F.C. Divinity Hall, Aberdeen; Arthur Hewett Spokes, B.A., University College; Charles Alfred Weber, B.A., University College.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopaedic list of chemical papers published abroad during the past week, with abstracts of all interesting or advantageous abridgment. The two half-yearly volumes of the Chemical News, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, July 14, 1873.

Mode of Intervention of Water in Chemical Action during the Mixture of Saline Solutions, whether Neutral, Acid, or Alkaline.—M. Becquerel.—The author draws the following conclusions from his experiments:—(1). In the mixture of two neutral saline solutions giving rise to double decompositions, these decompositions are brought about by the intervention of the reactions of water on the constituents of the salts. (2). In the reaction of acid upon alkaline solutions, water is still the principal agent by whose intermediation it is effected. The affinity of acid and alkali, both anhydrous, plays only a feeble part in the production of electro-motive forces.

Thermic Researches on Saline Solutions.—P. A. Favre.—A thermo-chemical paper in continuation of the controversy now pending between Professor Thomsen on the one hand and certain French savants on the other.

Reduction of Platinum Salts by Hydrogen Gas.—M. Merget.—The author finds that salts of platinum, like those of silver, cannot be reduced by a current of pure hydrogen. If a trace of arsenic is present the reduction takes place.

Dissociation of Red Oxide of Mercury.—H. Debray.—M. Myers, who has recently investigated the same subject, has inferred that the dissociation of oxide of mercury up to a limit of 400° is quite normal, but that the tension reached does not lessen on cooling. Above 400° there is no longer a maximum tension, the decomposition becoming total after a sufficient time. The author does not consider this view justified by the experimental results of M. Myers.

Oxalines or Ethers of Glycerin and of the Poly-atomic Alcohols.—M. Lorin.—Oxalic acid and glycerin give rise to oxalin, a solid white body, silky like acetamide, hygroscopic, and of a fatty aspect. If heated, it melts, gives off vapours, liberates carbonic oxide, and leaves a residue of glycerin. Ammonia converts oxalin into oxamide. Oxalic acid yields a compound resembling mannite. The author has previously pointed out the formation of a substance of the same type, resulting from the action of oxalic acid upon glycol.

"Turbinage" of Frozen Wines.—M. Melsen.—Alcohol is totally absent in ice produced in the midst of vinous liquids. The turbine used in sugar refineries to separate the crystals of sugar from the treacle is the best instrument for separating this ice from the concentrated wine.

Theory of the Planet Saturn.—M. Le Verrier.—This forms the twenty-first chapter of the author's "Recherches Astronomiques."

Note on the Isochronous Regulator constructed by M. Breguet for Observation of the Transit of Venus at Yokohama.—M. Yvon Villarceau.—This instrument appears in the Vienna Exhibition.

Modifications of the Magnetic Power of Steel by Tempering and Annealing.—M. Jamin.—Soft iron takes the greatest temporary magnetism; tempered steel receives much less; and the less, the greater the hardening

effect produced. A hard bar of cast steel, annealed to red, gave a separative force of 1290 grms. for a current of twelve elements. Hardened and subjected to the same conditions, it showed a force of only 75 grms. Steels of good quality, in thin plates and greatly hardened, are absolutely unfit to become permanent magnets; poor steels retain the polarity, and may be made powerful magnets after great hardening, and without annealing. All kinds of steel attain a maximum for their co-efficient of polarity, but in different conditions; poor or average steels, after rigid hardening; rich or refractory steels, greatly hardened, after a measure of re-heating, the temperature of which is higher in proportion to the degree of previous hardening. If one wishes, with a given steel, to make the best possible magnets, this maximum must be reached, and so different steels must be differently treated, as described. There is no fixed rule (as to degree), but the particular treatment can be readily ascertained from previous treatment of a specimen. The author gives a table of values of magnetic power and co-efficient of polarity for various steels.

Degree of Visibility which can be Reached with Astronomical Telescopes of Small Dimensions.—M. D'Abbadie.

Direct Demonstration of the Fundamental Principles of Thermo-Dynamics; Laws of Friction and Impact according to this Science.—M. Lédier.—The author starts from the distinction between the motion of the *ensemble* of a system and the proper motion of its atoms; the latter being resolved into motion corresponding to change of volume in the body and vibratory motion. Having examined the various movements of atoms, he ranges the forces actuating them in three categories: (1) those measurable physically, among which are gravity, muscular force, pressure of fluids against the sides of vessels, &c.; (2) irregular molecular forces, such as act between the atoms of solid bodies; and (3) irregular or erratic molecular forces, first among which are the forces called calorific.

Note on Magnetism.—M. Du Moncel.—This refers to a recent experiment by M. Gauguin. When a soft iron armature is applied to the polar faces of a horse-shoe magnet, the magnetisation, shown by induction currents, is found increased throughout the extent of the magnet, even to the curve. He thought this to be at variance with the general idea of magnetic condensation. M. Du Moncel thinks he here confounds two different magnetic actions; one is a dynamic action, operating as in Ampère's solenoids, the centre of which corresponds to the middle of the magnetised core; and to this belong the effects of induction produced by magnets, and the attractive forces between them and the currents. The other is a static action, constituting the attractive force proper and the magnetic polarities. These two actions may be produced independently of each other. The magnetic condensation, which M. Gauguin disputes, is the result of the polar action. It is a sort of reflex action between the armature and the pole, not displacing the magnetism from one end of the magnet to the other, but calling forth, molecularly, a greater quantity of magnetism, and producing a change of orientation in the axes of the atomic polarities of magnetic molecules, which form the series of currents of the magnetic helix. Two consequences flow from this. First, the atomic polarities being super-excited, the molecular currents have more energy, and the magnetic solenoid acts with greater intensity; hence the increase of the induced currents. Second, the polarities determining attraction being displaced or concealed more or less by the reflex action of the armature, all the atomic polarities in the different parts of the magnet are displaced in the same way, in order to equilibrium. Hence, there is either a general weakening in the external polarities of the magnet when its two poles are in contact with the armature, or a weakening of one pole and strengthening of the other when the armature is in contact with one pole only. The

author adds some further proofs of magnetic condensation, or of the prolonged concentration of magnetic polar actions at the surface of contact of two magnetic pieces. One of the most curious consequences of magnetic condensation is the retardation of the current of demagnetisation in a closed magnetic system, when one interrupts the voltaic current magnetising the system.

Variable Period in Closing of a Voltaic Circuit.—M. Cazin.—The result of experiment is stated in the following proposition:—Consider a voltaic circuit, the homogeneous wire of which presents some portions straight and some wound in spiral. If we call V the potential at one point, and x the distance from this to some other point in the circuit, reckoned along the wire, the differential co-efficient $\frac{dV}{dx}$ has at each instant the

same value at different points of the straight portions; it increases gradually with the time. Remaining the same at different points of the wound portion, the elements of which are subject to equal inductive actions, the co-efficient increases at first very rapidly with the time, reaches a maximum, and decreases continually till it has the same value as in the straight portions; the permanent state is then reached. Thus, in the variable period of

closure, $\frac{dV}{dx}$ is not a function of the time alone; it depends on x , and on the manner in which the circulations are disposed at the point considered. It is, further, proportional to intensity of current.

On a Barometer called Absolute.—MM. Hans and Hermans.—The principle is that of observing the motion of a point in the line joining the extremities of the columns in two parallel-placed thermometers, one air, the other mercury.

On a Means of Comparing Powders with one Another.—M. de Tromence.—The author explodes different kinds of powder by electricity, within a vessel enclosed in a larger vessel filled with water, and which serves as a calorimeter. The exploding body producing no dynamic effect the force is transformed into heat, which when measured indicates the absolute force of the powder.

Researches on the History of Digestion in Birds.—M. Jobert.—The gizzard is not exclusively a triturating organ but a chemical stomach, which secretes an acid liquid.

Observations on some Liquids of the Organism of Fishes, of Crustacea, and of Cephalopoda.—MM. Rabuteau and Papillon.—The authors found urea and methylamin in the peritoneal liquid of the ray, squal, torpedo, and other fishes. Chlorhydric acid was obtained from the gastric juice of the ray. The blood of the poulp and the crab gives no absorption band in the spectroscopic, becomes slightly blue in air, and loses the blue tint when carbonic acid is passed through it, resuming it when again agitated with air. It contains some urea, but the blood of the squal and ray contain a much larger proportion.

Heat of Combustion of Explosive Matters.—MM. Roux and Sarrau.

Revue Universelle des Mines, de la Metallurgie, des Travaux Publics, des Sciences et des Arts Appliqués à l'Industrie, March and April, 1873.

On Forms of the Hot-Blast Apparatus.—M. L. Gruner.—A mechanical paper.

Reply to M. Leseure's Note on the Memoir of Bochkoltz.—A controversial paper on the "Regenerator of Force."

Condition of Mines in the Island of Sardinia.—M. Sella.—A detailed account of the lead and zinc mines in that island, with analyses of the chief kinds of ore.

Conditions under which Supersilicated Cast Metal is produced in Blast-Furnaces.—Samson Jordan.—This paper has been previously extracted.

Auriferous Region of Frasconi.—C. Sagey.—The mineral contains, on an average, 105 grms. of gold and 62 of silver per ton, representing a value of 366 francs.

New Methods of Determining Iron and Alkalies Volumetrically.—J. Charpentier.—These methods are based on the employment of alkaline sulphocyanides, and on the well-known reaction ensuing when they are brought in contact with a per-salt of iron. If, into the red liquid formed by adding a solution of an alkaline sulphocyanide to a solution of a per-salt of iron, there be poured a caustic alkali, the red colour disappears, peroxide of iron is thrown down, the alkaline sulphocyanide being re-constituted. Other things being equal, it is necessary to add so much the more alkali the more iron there is in the original solution. To titrate the alkaline liquid employed in the operation, dissolve 5 decigrams of pure iron in very dilute hydrochloric acid. It is very important that this solution is exempt from free acid, and that all the iron is in the state of sesquioxide, the latter condition being attained better by means of chlorate of potash than of nitric acid. This solution is diluted with water to the volume of a litre. Of this, 100 c.c. are placed in a white porcelain capsule, and a few drops of sulphocyanide of potassium are added, when the liquid takes a deep blood-red colour. By means of a graduated burette, caustic potash is then added, of such a strength that about a buretteful would be required to saturate a litre of the iron solution. The red liquid becomes gradually turbid, and then suddenly grows colourless, whilst the sesquioxide of iron is precipitated. The amount of alkali consumed is read off. The same alkali is then used to titrate the remaining 900 c.c. of iron solution. The number of degrees, increased by $\frac{1}{10}$, is the strength of the alkali sought for. These points being arranged, in order to analyse any ferruginous matter—whether ore, slag, or mineral water—a neutral solution in water or hydrochloric acid is prepared, diluted to a litre, and, after the addition of sulphocyanide of potassium, is titrated as above.

If the number of degrees found is N , then $\frac{N}{10}$ is the proportion of iron in the body under examination, N being the number of degrees of alkali required for the standard iron solution. In case of a mixture of protoxide and sesquioxide, commence by determining the pre-existing sesquioxide as above, avoiding contact with air, and adding chloride of ammonium to hinder the precipitation of protoxide of iron. A second portion is then perfectly peroxidised, and the total iron is determined. The difference shows the amount of protoxide. In this case, it is advantageous to replace the potash with ammonia. If desired, the iron solution may also be poured into a known and fixed amount of alkali, mixed with sulphocyanide. The appearance, not the disappearance, of the red colour is here decisive. After the application of this method to any given sample, the analysis can, if required, be completed by the ordinary gravimetric method. If the substance under examination contains substances precipitable by ammonia, and this alkali is employed, their precipitation may be hindered by means of chloride of ammonium; such substances are—Lithia, baryta, strontia, lime, magnesia; the protoxides of manganese, iron, zinc, cobalt; oxides of cadmium, silver, platinum, rhodium, osmium, and ruthenium. The following oxides are not thrown down by an excess of potash:—Lithia, baryta, strontia, alumina, glucina, oxides of zinc, chrome, lead, platinum, tin, palladium, rhodium, osmium, and gold. In this case, potash is employed as the standard alkali. In most cases, foreign substances do not interfere. This holds good with silica, the alkaline metals, the alkaline earths, alumina, manganese, zinc, cobalt, nickel, cadmium, chrome, lead, bismuth, silver, and all metals which give white precipitates with alkaline sulphocyanides. The application of the method to alkalimetry is based upon the following reaction:—If an excess of caustic alkali is present in a liquid along with a little sesquioxide

of iron recently precipitated, and if hydrochloric acid is gradually added, as soon as the alkali is saturated, the oxide of iron is attacked, and a ferric solution formed, which immediately gives a blood-red colouration, an alkaline sulphocyanide having been added as indicator. The method is, of course, acidimetric as well as alkalimetric. The author thinks that the method can be extended to the determination of silver, chlorine, and lime.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, par Ch. Méné, No. 50, August 19, 1873.

New Mode of Silvering Glass.—M. Siemens.—Aldehyd has been long ago employed for silvering glass by Liebig's process, though the difficulties of manipulation are considerable. Siemens has improved the process by treating aldehyd with thoroughly dry ammoniacal gas. Of this liquid 2.5 grms., and 4 grms. nitrate of silver, are taken, and each is dissolved separately in water, the total amount of which is 1 litre. The two solutions are then mixed and filtered. The object to be silvered, cleaned so as to be quite free from grease, is immersed in the liquid, and heated gradually up to 50°. When this point is reached, the deposition of the metal begins in a very thin layer, dark at first, but gradually acquiring the metallic lustre. As soon as the incrustation has acquired the ordinary whiteness and lustre, the object is withdrawn from the liquid.

New Process for Preparing Anthracen.—When coal-tar is distilled with a view to the preparation of anthracen, it is necessary to push the process to its farthest limit; that is, to separate from the tar the largest possible amount of heavy oils in which alone the anthracen is found. The process hitherto employed has failed in extracting from the tar a quantity of oil containing anthracen at all proportionate to what exists in the mass. In fact, when, over and above the light oils, a quantity of heavy oils have been withdrawn equal to about one-fourth of the weight of the tar placed in the still, the operation is stopped, since the residual matter becomes viscid, and, conducting heat badly, tends to undergo decomposition and carbonisation, to the great detriment of the apparatus, which would be rapidly destroyed if the operation were further prolonged. The residue contains a large quantity of anthracen, which has hitherto been wasted. The new process consists in the use of agitators, by means of which the yield of heavy oils is raised to 40 per cent, showing a gain of 10 to 15 above the old process. The last portions of heavy oil, moreover, are richer in anthracen than the former.

Varnish or Size from Gum-Lac.—The solvent employed is carbonate of ammonia, in which the ground gum-lac is boiled till the ammoniacal odour has disappeared. It is recommended as a dressing for dark coloured textile fabrics.

Continuous Furnace for Burning Bricks, &c.—M. Esser.—A paper derived from English sources.

Improved System of Heating Gas-Retorts.—M. Rouget.—The author attains an economy of coke to the extent of 11 per cent, by arrangements calculated to intercept the radiation of heat from the front of the furnace and from the heads of the retorts.

Influence of India-Rubber Tubes on the Illuminating Power of Gas.—M. Zukowski.—The author shows that olefant gas and hydrocarbon vapours are absorbed by caoutchouc. Hence, tubes of this material are not admissible in experiments on the illuminating power of gas.

Use of Steam in Extinguishing Fires.—As a means of extinguishing fires, the author recommends the use of large pipes, communicating with a boiler, and capable of filling the building with steam in case of a conflagration.

Anthracen Blue.—M. Springmühl.—We have recently noticed this alleged novelty.

Scarlet Dye on Cotton with Magenta.—The cotton is first to be worked in a boiling decoction of sumac and turmeric, and then with the addition, after a few hours, of a little sulphuric acid. It is then, after cooling and washing, dyed in a luke-warm bath of magenta. (It is absurd to expect a good scarlet from any combination in which magenta is present. All magentas are more or less on the blue side of red, and even the slightest admixture of blue is fatal to scarlets).

New Galvanic Pile.—M. Chauderay.—The arrangement is intended for military telegraphic purposes.

Dyeing Wax Candles Black.—M. Böttger.—This effect is produced by heating the wax along with Anacardium nuts.

Imitation of Leather.—A mixture recommended consists of 16 parts of gelatin and 5 of glycerin. A colouring matter is then added as may be required, caoutchouc to give elasticity, and boiled linseed oil to render the whole sufficiently flexible. This composition is spread upon linen whilst hot, printed with any pattern desired. The surface is then treated with a solution of alum, sulphate of iron, copper, or zinc. These saline solutions may likewise be mixed with the composition before it is spread on the linen. The surface is lastly varnished, and may be bronzed or gilt. Another composition is obtained by boiling linseed oil with quick-lime and borax, which forms a liquid that, on cooling, becomes a thick paste. It is then mixed with rasped cork and more quick-lime.

Rapid Process for Reducing Old Silver (Photographic) Baths.—M. de Krueger.—The mixed silver residues are well shaken up with phosphoric ether, when a black precipitate is deposited, which is filtered off, washed, and boiled in a strong potash lye, yielding metallic silver.

Removal of Potassic Salts from the Solutions Obtained in the Manufacture of Beet-Root Sugar.—Messrs. Duncan and Newlands.—The patentees claim the separation of potash and ammonia by the employment of tartaric acid or acid tartrates, and the separation of the same bases by means of sulphate of alumina.

Archiv für Pharmacie, Band ii., Heft 6.

Microscopic Examination of Spring Water.—E. Reichardt.

On Sugar in the Roots of Grass, and on Triticin—A New Hydrate of Carbon from the Roots of Triticum.—Herm. Müller.

Examination of Aqua Amygdali.—A. Koster.

Amount of Copper in Water passed through Copper Service Pipes.—E. Reichardt.

Examination of Sausages Coloured with Anilines.—E. Reichardt.

On Antique Bronze.—E. Reichardt.

On Vanillic Acid.—P. Charles.

Action of Certain Organic Acids on the Development of Mouldiness.—H. Werner.

Neues Repertorium für Pharmacie, No. 6, 1873.

Toxicological Studies on Hydrocotamin.—F. Falkl.

Effects of Eucalyptol.—M. Bing.

History of Eucalyptus Globulus.—M. Bing.

Influence of Absolute Alcohol upon Certain Chemical Reactions.—Aug. Vogel.

Influence of Active Oxygen upon Pyrogallal Acid.—H. Struve.

Acid Reaction of Chloral Hydrate.—H. Struve.

Rapid Method of Drying Flasks, Tubes, &c., and on a Convenient Junction of Wide and Narrow Tubing.—Emi Zettnow.

Behaviour of Camphor-Cymol in the Animal Organism.—E. Ziegler.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, Tome xxxi., No. 14, July 31, 1873.

Rewards for Inventions.—Count De Drouet, in the session of the National Assembly, July 22, proposed a reward of a million francs to anyone who may succeed in forming ferrocyanides, nitrates, or ammoniacal salts from the nitrogen of the atmosphere for manurial purposes, provided that such manures shall be cheaper by at least 10 per cent than the analogous manures now in the market. For the discovery of a substitute for coal he proposed the reward of a million and a half.

Preservation of Gum Arabic from Mouldiness.—Hirschberg adds for this purpose a little sulphuric acid to the solution, and finds that the mixture retains its adhesive property uninjured after the lapse of eighteen months.

Revue Scientifique de la France et de l'Etranger, July 26 and August 2, 1873.

These numbers contain no original chemical matter.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the manufacture of salt, and in apparatus employed therefor. Robert Williamson, salt manufacturer, and Josiah Dale, manager, Wincham saltworks, Northwich, Cheshire. December 26, 1872.—No. 3030. First. Brine is evaporated by steam applied directly to the upper bottom of a pan, called pan A, such steam being generated from water contained within a double bottom, the fire or flames and heating gases acting on the water-covered outer bottom. Second. Steam from pan A, or other steam, is led through a series of pipes in another pan, called pan B, such pipes being movable up and down, centre steam-tight joints being provided. Third. The movable pipes under the above second part are balanced by weights and weights connected thereto. Fourth. Hot brine is pumped to pans by the feed pipe being fed through hot water. Fifth. Brine, hot or cold, is supplied to pans through small apertures in pipes, or through a series of small nozzles.

Improvements in treating phosphatic compounds, and in obtaining and applying useful products therefrom. James Higgin, Manchester, and John Stenhouse, Pentonville, Middlesex. December 30, 1872.—No. 3349. We precipitate arseniates, arsenites, or phosphates from the waste liquors resulting from the so-called "dugging" process, applied for the fixation of mordants on textile fabrics and yarns, by an addition of muriate of lime or other suitable earthy or metallic salt, and after collecting the precipitate on a filter, decompose it by carbonate of soda or other suitable alkaline salt, reproducing thereby a liquid or salt similar to that originally employed for the "dugging" process. We can, where preferable, precipitate insoluble arseniates, arsenites, or phosphates at the same time as fatty and colouring precipitates, by running the waste soap liquor and the waste "dugging" liquor into the same pit, and precipitate the mixed liquors by muriate of lime or other suitable agent, dissolving out from this precipitate the arsenites, arseniates, or phosphates by suitable acids, and from this solution, by addition of lime or other alkaline agent, we obtain a precipitate, upon which we operate in the same manner as the precipitate from waste "dugging" liquor alone. We treat the fatty compound left by one of the processes described in the Specification of Letters Patent granted to John Thom and John Stenhouse, dated July 22, 1872, No. 2186.

Improvements in the treatment of maize and other like grain for the production of starch therefrom, and in the utilisation of the waste products for the manufacture of cardboard and paper, and for the preparation of soaps. John Henry Johnson, 47, Lincoln's Inn Fields, Middlesex. (A communication from Eugène Leconte, Paris). December 30, 1872.—No. 3356. This invention consists of a process for obtaining starch in a rapid and economical manner from maize by mechanical means, and in applying the ligneous residues or products to the manufacture of paper-pulp, and the fatty products to the preparation of soap. The essential feature of the process is the entire complete separation of the three component elements of the maize, viz., the starch, the ligneous and fibrous matters, and the fatty astringent matters.

Improvements in the production of iron. John Watson Spence, Newcastle-on-Tyne. December 30, 1872.—No. 3357. This invention consists in the production of iron by bringing reducing gases, or, if necessary, gases and air, under pressures in contact with oxides, or oxides and fluxes, or oxides, fluxes, and carbonaceous materials, in a furnace or reducing chamber, where they have previously, or not, been brought to a temperature sufficiently high to enable combination to take place, thereby reducing metals from their oxides direct as a successful commercial operation.

Improvements in the treatment of paper and other materials for the production of imitation or artificial leather. John Harrington, Ryde,

Isle of Wight. December 31, 1872.—No. 3050. The invention consists in taking strong paper, and staining or dyeing it to any desired colour as a ground colour, and then colouring the surface thereof to the tint required; the paper is then glazed, and afterwards waterproofed by the application of a solution of shellac thereto. In certain cases glycerine is applied to the paper to produce a great degree of pliability; or, in some cases, the glycerine may be mixed with the dye. The paper is then, if preferred, grained as described in Specification of Patent No. 2213, 1872.

New or improved methods, processes, and apparatus for depositing upon wrought-iron, steel, and cast-iron, layers of copper or alloys of copper. John Henry Johnson, 47, Lincoln's Inn Fields, Middlesex. (A communication from Octave Gaudin, chemist, Jean Baptiste, Java Mignon, and Stanislas Henry Rouart, builders, all of Paris). December 31, 1872.—No. 3320. This invention relates to different processes and apparatus for depositing on wrought-iron, steel, or cast-iron, coats or seams more or less thick, but adherent and continuous, of copper and alloys of copper. The said process may be summarised up as follows:—1st. A dry process, and the necessary apparatus peculiarly applicable for depositing thick seams of metal, as on printing cylinders, machine chairs, &c. 2nd. A dry process of precipitation, with or without using electricity, based on the decomposition of simple or compound salts of copper kept in fusion. 3rd. A humid process of precipitation of copper and of its alloys, with or without using electricity.

NOTES AND QUERIES.

Cyanides in Gas Waste Products.—Nitrous Acid from Sulphuric Acid Chambers.—I am mentioned made in Wagner's "Technology" of a method of utilising the cyanides in gas waste products. In the *CHEMICAL NEWS* it is stated that lime has been successfully used for the collection of the escaping nitrous acid from sulphuric acid chambers. Can your readers inform me if I can obtain full particulars of these processes from any source?—E. QUAKER.

TO CORRESPONDENTS.

E. W.—Communications for "Notes and Queries" column are for the benefit of the readers of the *CHEMICAL NEWS*. Purely business communications must be made known, in the usual manner, through our advertisement columns.

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THE CHEMICAL NEWS.

VOL. XXVIII. No. 716.

THE CHEMICAL CONSTITUTION OF SUCCINIC MALIC, AND TARTARIC ACIDS, CRITICALLY EXAMINED AND INTERPRETED

FROM THE STAND-POINT OF THE
"TYPO-NUCLEUS" THEORY.

By UTO RICHTER, Ph.D.

AMONG the leading combinations of organic chemistry, the family group comprising the water-salts of succinic, malic, and tartaric acids has always been regarded with special and absorbing interest, not only on account of the vast multitude and diversity of substitution-products and derivatives which these water-salts are capable of furnishing, but more emphatically on account of the deep import and significance which all these bodies are felt to possess in a theoretical point of view. With a well-stocked magazine of precious materials at their disposal, our modern speculators have certainly not been sparing in their efforts to unravel the genetic relations and molecular structure of this particular class of molecules. I, for my part, having, years ago, become convinced of the utter futility of these efforts, so long as they continue to be based upon the more or less crude and deceptive principles of the dominant school philosophy, and sincerely believing that my own speculations on this subject are calculated to throw a brighter and purer light upon this intricate, but all-important question, I have thought it my duty to embody the main results of my researches in the present communication. For this purpose I have drawn up the following programme, which consists of three parts. In the first part I shall expound the molecular changes that accompany the natural production of the water-salts of succinic, malic, and tartaric acids in the living organism. In the second part I shall describe the various metamorphoses which these water-salts are prone to experience under the influence of heat and oxidising agents. In the third, and last part, I shall elucidate the molecular changes that attend the artificial production of these water-salts in our laboratories.

Having now acquainted the reader with the leading topics of my programme, I shall at once proceed to direct his attention to those weighty and important matters which form the subject of the first part.

PART I.

On the Principal Molecular Changes that accompany the Natural Production of the Water-Salts of Succinic, Malic, and Tartaric Acids in the Living Organism.

The proper treatment of this question demands that I should enter first of all upon a minute analysis of the chemical origin and mode of formation of the so-called polyatomic alcohols. Apart from the well-established fact that genuine specimens of this type can be formed artificially by subjecting the corresponding hydrocarbons to the action of chlorine, and displacing the directly-absorbed chlorine molecules by an equivalent number of hydroxyl molecules, the more recent experiments of Berthelot and others, devised with the object of studying the effects of oxidising agents upon the free hydrocarbons, tend to the conclusion that these substances are produced in the living organism by the action of atmospheric oxygen upon certain kinds of native hydrocarbons, with which the juices of plants and vegetables are always more or less impregnated. Taking this for granted, and confining my remarks to that variety of hydrocarbons which are called "olefines," and whose chemical constitution is expressed

in my system by the general formula $2H_mC_m$ ($m=1, 2, 3$, &c.), I shall yet venture one step farther by maintaining that the said alcohols are the true parent molecules to that particular class of combinations which claims the three acids of the text for its most familiar and most thoroughly investigated representatives.

Now I have good reason for believing that organic acids, which are descended from an olefine-begotten polyatomic alcohol, are produced in Nature's laboratory by a method which, in its general outline, may be roughly described as a process of slow and gradual combustion, in the course of which a certain number of the constituent formic alcohols (*vide infra*) are made to pass from the category of genuine alcohols into the category of genuine acids, while the alcohol rest re-enters into chemical union with these freshly-formed acids under the typical form of a more or less complex halogen adjunct. According to this view, every olefine-begotten polyatomic alcohol contains within its sphere and substance the germs for the generation of an organic family group whose heterologous members, however widely they may differ from each other in chemical composition and properties, have this important point in common, that they contain the same equivalent number of carbon molecules as the alcohol from which they are descended. The theoretical significance of this rule will be more fully understood in the sequel, where I hope to furnish convincing proof that the three organic acids before us stand to each other in the relation of true heterologues, and that the so-called erythrit, which is a species of saccharine matter endowed with all the characteristic properties of a tetraatomic alcohol, has strong claims to its being regarded as their natural and legitimate progenitor. In order to elucidate the precise nature of these curious, but, as yet, very imperfectly deciphered family relations, I shall require to inaugurate the discussion by a description of the molecular changes which accompany the aforementioned process of slow and gradual combustion from one stage of the process to the other.

The first effects of the action of oxygen on a given olefine are supposed to be of a purely catalytic character, and to consist in the conversion of the hydrocarbon from its primitive or normal state of existence into one of its possible isomeric modifications. In this altered form the hydrogen and carbon constituents have re-arranged themselves in accordance with the formula—



which implies that 2 molecules of hydrogen have become detached and typically changed into acid hydrogen nuclei, and, further, that one of these nuclei has re-united as principal with the rest of the hydrocarbon, which, relatively to that principal, is now destined to play the part of an adjunct, while the other, by appropriating 2 carbon molecules from the said adjunct, has given rise to a formen-holding hydrogen nucleus, $2C_2; H_2$, where the hydrogen and carbon are likewise destined to discharge the relative functions of principal and adjunct. Thanks to their freshly-acquired dissimilar electro-polar energies, these two differently modified hydrogen nuclei are now in a fit and proper condition for chemically combining with each other so as to produce the aforesaid complex molecule, whose first hydrocarbon adjunct is therefore composed of an olefine differing by $2H_2C_2$ from the parent hydrocarbon, while the second adjunct consists invariably of a molecule of formen.

It is here necessary for me to inform the reader that, by

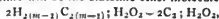
* The reader will bear in mind that the various marks of punctuation used in my formulae are typical symbols of molecular grouping. Thus, a dot connects the base with its acid; a semicolon connects the hydrocarbon adjunct with its principal; an inverted semicolon connects the halogen adjunct (which includes every species of mono- or poly-normal acids, bases, or salts) with its principal; and a colon connects two or more simple hydrocarbons with one another. Observe, also, that in my rational formulae the non-essential constituents are generally separated from the essential constituents by a horizontal line, and that the empirical formulae used in my system are exactly the double of the ordinary formulae: $H_2=2; C_2=12; N_2=14; O_2=16$.

my fundamental law of meta-chemical order of grouping, which presides over the collocation of the component groups of the molecules, the olefine-holding hydrogen nucleus stands lower in that order than the formen-holding hydrogen nucleus. Moreover, while both these hydrogen nuclei are held to play relatively to each other the part of co-ordinate principals, the former, from being more electro-positive, is understood to occupy in the system an inferior and more central position, in consequence whereof the first of these differently modified hydrogen nuclei is predestined to furnish the stronger, because more electro-positive, ether base, which, by the law of elective affinity, in the sense I take it, is pre-disposed to take possession of the stronger, because more electro-negative, acid.

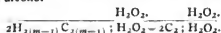
In order to express these hitherto obscure and undefined relations in technical language, I shall retain the term "principal" for the lower-ranking hydrogen nucleus, and apply the term "ally," to the higher-ranking hydrogen nucleus, allowing a further distinction between the first, second, third, &c., ally in all those cases where, as I shall presently show, the continued action of oxygen on the first hydrocarbon adjunct tends to the formation of two, three, or more formic ether molecules.

From the preceding remarks the reader cannot fail to perceive that, so far as it goes, my theory of the chemical constitution of the olefine-begotten polyatomic alcohols is not only exceedingly plain and transparent, but that it is susceptible likewise of a high degree of expansion and development. This theory is based upon an original conception, which, in its widest acceptance, may be briefly enunciated as follows:—"So long as a given hydrocarbon preserves its primitive or normal form of molecular arrangement, and which is characterised amongst others by the typical identity in the mode of aggregation of its more or less condensed hydrogen and carbon constituents, the whole system may be said to exist potentially in a state of chemical passivity, whereas, after merging into one of its possible isomeric modifications—that is, when a certain number of its component hydrogen or carbon molecules have assumed the acid-nucleus form of arrangement—this now typically altered system may be said to exist potentially in a state of chemical activity, because it has now acquired the faculty of entering into direct chemical union with oxygen and other metallic or non-metallic elements, for which these acid nuclei present in their respective envelopes a firm and solid point of attachment."

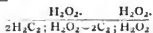
In obedience to this all-important law, the first and immediate product of the direct union of oxygen with a given olefine will be the biatomic ether molecule—



which, in the presence of water, will speedily combine with 2 molecules of that element, with production of the biatomic alcohol—



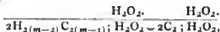
Accordingly, this latter formula may be taken to express the chemical constitution of the "glycols," among which ethylen-glycol—



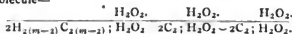
stands first in the series.

Let us, in the next place, contemplate the molecular changes which accompany the continued action of oxygen on the end-product of the preceding metamorphosis. These changes I believe to consist in the further abstraction of 2 molecules of hydrogen from the olefine adjunct, and their conversion into 2 molecules of water. At this point, two alternatives present themselves for consideration. These water molecules may either be set at liberty, or, by appropriating a molecule of formen from the olefine rest, they may become re-employed in the construction of a triatomic alcohol, which will then be com-

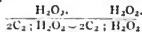
posed of one olefine-holding principal and two formen-holding allies. Obviously the former alternative, which exercises no modifying influence over the biatomic character of the new compound, ought to give rise to the molecule—



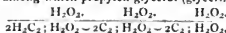
while the latter alternative, which imparts triatomic properties to the new compound, ought to give rise to the molecule—



Accordingly, the first formula may be taken to express the chemical constitution of the "deglycols," among which deethylen-glycol—

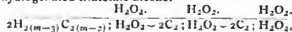


stands first in the series, while the second formula may be taken to express the chemical constitution of the "glycerols," among which propylen-glycerol (glycerin)—

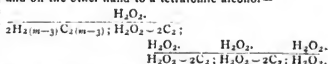


stands first in the series.

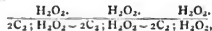
Let us once more contemplate the molecular changes which accompany the continued action of oxygen on the end-product of the preceding metamorphosis. It is clear that this action ought to give birth, on the one hand to a dehydrogenated triatomic alcohol—



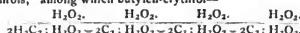
and on the other hand to a tetraatomic alcohol—



which will be composed of one olefine-holding principal and three formen-holding allies. Accordingly, the first formula may be taken to express the chemical constitution of the "deglycerols," among which depropylen-glycerol—



stands first in the series; while the second formula may be taken to express the chemical constitution of the "erythrols," among which butylen-erythrol—

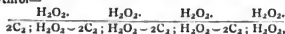


stands first in the series.

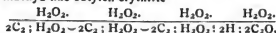
It is of importance to point out that my peculiar mode of reasoning, which it is needless to pursue any farther, has actually brought us face to face with the identical alcohol which, as already observed, claims to be regarded as the true progenitor of the three organic acids that form the subject of this paper. Having, therefore, adopted the last-mentioned formula as a safe and trustworthy basis of reasoning, I have founded thereon what seems to be a perfectly rational, harmonious, and comprehensive theory, concerning which I make bold to affirm that it brings to light the true genetic relations and molecular architecture of that almost overwhelming mass of substitution-products and derivatives, among which our triad of acid heterologues has long been conspicuous as the starting-point for an extensive series of highly interesting and instructive experiments.

It was stated above, as one of two possible alternatives, that, under the stimulus of oxygen, the olefine-begotten polyatomic alcohols are disposed to surrender to that element two of their constituent hydrogen molecules, which are immediately eliminated in the form of water. Now I have good grounds for believing that the residual

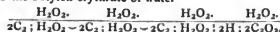
de-alcohols, as I will shortly call this class of compounds, are very prone to merge into an isomeric modification, where they become endowed with the same feebly acid properties, together with the power of precipitating silver from its salts, which characterise the aldehyds of the monoatomic system. According to this view, the butylen-erythrol becomes first of all converted into the debutylen-erythrol—



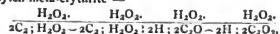
which, by the conversion of the third formyl alcohol ally into the isomeric formite of water, soon changes into the aldehyd-like butylen-erythrite—



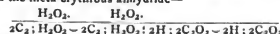
and thence, by the absorption of 2 molecules of oxygen, into the butylen-erythrate of water—



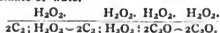
In the next stage, the monobasic butylen-erythrate is made to merge into the isomeric modification of the bibasic butylen-meta-erythrite*—



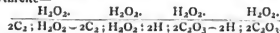
the metamorphosis being accomplished by the second formen-holding ally of the colligated depropylen-glycerol changing into the isomeric formite of water, the formous acid constituent of which is now made to play the part of principal, while the formic acid constituent exchanges its function of principal for that of ally. In the last stage, the meta-erythrite resolves itself into 2 molecules of water, and the meta-erythrous anhydride—



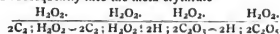
which, by the method of orthogenesis (Part II., c. i., 3), becomes finally transformed into ortho-erythrite, or ordinary succinate of water—



The reader cannot fail to perceive that, in order to explain the natural production of the malate and tartrate, it is only necessary to suppose that the meta-erythrite of water has become further oxidised, first into the meta-erythrite—

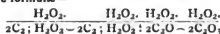


and subsequently into the meta-erythrate—



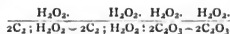
and that these compounds have then experienced a series of molecular changes precisely similar to those I have just shown to accompany the conversion of the meta-erythrite into the ordinary succinate.

In glancing at the formula of this latter compound, we might be led to imagine that it belongs to the class of readily-oxidisable aldehyds, and consequently that it should be possible to obtain therefrom, by direct oxidation, the ortho-malate and ortho-tartrate, which, by their respective formulæ—



* Let it be borne in mind that, in my theory, all those organic combinations are understood to belong to the class of polybasic meta water-salts, which, besides containing for their halogen adjunct a mono- or poly-atomic de-alcohol, include among their acid constituents two molecules at the least that are moulded on the formyl type. Again, all those organic combinations are understood to belong to the class of polybasic ortho water-salts, which, besides containing for their halogen adjunct a mono- or poly-atomic de-alcohol, include among their acid constituents not a single molecule, or, at the most, one only, that is moulded on the formyl type, while the rest are all moulded on the oxalyl type.

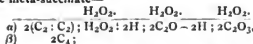
and—



are at once recognised as the two nearest upper heterologues of the succinate, these formulæ being at the same time well adapted to illustrate the all-important law that the oxidation always progresses from right to left, in the present instance from the side of the oxalous acid ally towards the side of the oxalous acid principal. Yet, strange to say, all attempts to oxidise the succinate by direct methods have invariably proved a failure.

In pondering the probable cause of this discrepancy, I could not help being struck with the scarcely fortuitous circumstance that in my system the true aldehyds are all constructed on the formyl type, with an uneven hydrocarbon for their adjunct, whereas the succinate and its homologues are all constructed on the oxalyl type, with a mono- or poly-atomic de-alcohol for their adjunct. Now, it is perfectly conceivable that these typical differences are of a nature to exercise a certain modifying influence upon the intensity of attractive force, which the carbon nuclei of these two kinds of acids are capable of concentrating upon a contiguous molecule of oxygen. But, while I shall be glad to learn that within the precincts of one of our laboratories this problem of direct oxidation has at length received a practical and commercially-profitable solution, I am strongly impressed with the notion that in the living organism this metamorphosis is accomplished by a different and presumably far more feasible method.

This method I hold to consist in the previous conversion of the ortho-succinate into the isomeric modification of the meta-succinate—



which, on the hypothesis that its complex carbon adjunct is capable of assuming two typically-distinct forms of grouping, is here represented as occurring in an α and β variety.

According to my view, the two acid constituents being now moulded on the formyl type, become thereby capacitated to impart to the meta-succinate the chemical character and properties of a true aldehyd, which, by the accession of one pair of oxygen molecules to the formous acid principal will give rise to the meta-malate, and, by the accession of a second pair of oxygen molecules to the formic acid ally, will give rise to the meta-tartrate, whence the ortho-malate and ortho-tartrate will then be finally produced by the method of orthogenesis, for which the reader has already been referred to the second part of this paper.

Having now briefly delineated the main features of those natural processes, whereby the three acid heterologues of the erythric family group are supposed to be engendered in the interior of plants and vegetables, I shall proceed to the second part of my programme, for which I have reserved the disclosure of a new set of molecular relations and modes of grouping, the theoretical importance of which can scarcely be over-estimated.

(To be continued.)

CALORIMETRIC PYROMETER FOR THE DETERMINATION OF HIGH TEMPERATURES.

THE problem of the determination of temperatures higher than that of the boiling-point of mercury has not been solved in a satisfactory manner. M. J. Salleron describes in *Les Mondes** an instrument which, founded on the principle of the calorimeter, he thinks unites the best approximative conditions with practical simplicity. The instrument consists of a cylindrical vase of red copper open at its upper end, and surrounded by an outer

* Vol. xxxi., No. 13.

envelope of brass. The red copper vase is supported in this outer vessel by means of an annular disc of wood. A layer of air thus separates the two vessels, and this arrangement has for its end the diminishing of the loss of heat by radiation and also by conduction. For the same reason, the mouth of the vase is closed by a wooden cover pierced with an opening. By this opening, there are introduced into the calorimeter determined weights of water, and a heated mass of red copper. This piece of copper (in the shape of a bolt) rests on an arm passing through the wooden cover, and the arm is susceptible of such movement as will enable the operator to agitate, and with the hot copper bolt equally heat, the liquid in the vase. The heat of the liquid is determined by means of a thermometer.

To use the apparatus, half a litre of water is measured into the copper vase, and its initial temperature, t , noted by means of the thermometer. The cylinder of red copper (which weighs 106 grms.) is placed in the furnace of which it is desired to ascertain the temperature, T , and, when heated, is rapidly immersed in the water of the calorimeter. The water is agitated until equally heated; and, during this time, the mercury of the thermometer first rises rapidly, then more slowly, and finally becomes for a few instants stationary before it commences to fall. The final maximum temperature, t' , is noted, and the temperature, T , found by the formula $T = 50(t' - t) + t$. Thus, if before the immersion of the copper cylinder the temperature were 15° , and afterwards 25° , the temperature of the heating source would approximate—

$$[50(25 - 15) + 25 = 525].$$

Platinum may be substituted for copper for temperatures above 1000° .

The method supposes that, at the instant of its immersion, the copper or platinum cylinder possesses exactly the temperature to be measured. To realise this condition, it is necessary to take precaution against loss of heat during its transport to the calorimeter. With this view, M. Salleron introduces the copper cylinder into an iron tube, provided at one extremity with a wooden handle, and at the other with an opening only sufficiently large to admit of the passage of the cylinder. This opening is excentric with relation to the axis of the tube, so that the weight introduced into the tube is maintained there when the tube is held in one direction, and will fall out when the tube is turned half round in the other direction. A copper cylinder is introduced into the tube, and this into the source of heat until the copper is raised to a temperature uniform with the source of heat, when the tube is removed, quickly carried to the calorimeter, and, by a half-turn, the copper cylinder is thrown into the water. The heat of the iron tube practically prevents radiation from the copper cylinder.

ON THE ENERGIES OF THE IMPONDERABLES, WITH ESPECIAL REFERENCE TO THE MEASUREMENT AND UTILISATION OF THEM.*

By the Rev. ARTHUR RIGG, M.A.

(Continued from p. 63).

To return, then, to Kater's experiments. He had first to determine a pendulum which should vibrate seconds in the latitude of London. He did it in the house of Mr. Brown, in Portland Place, which house has an astronomical bearing from Portland Chapel of 74° deg. 38 min. 30 sec. west from north, the distance being 283 feet, and therefore the house is about half-way up Portland Place on the left-hand side. In that house the pendulum was first adjusted. Nothing seems easier than to deal with a simple vibrating ball on a string. It is not, however, so easy as it seems. It can

* The Cantor Lectures, delivered before the Society of Arts.

not be made to swing in the same plane as this one now appears to do. If left free to choose its plane of vibration it is seldom contented. It will not have a dozen swings in the same plane; it must, therefore, somehow or other, be made rigid, and so prevented from such vagaries. Here is a small vessel of lead, hanging by a bundle of untwisted fibres from a hook, and you might think nothing could be easier than to let it swing backwards and forwards on the same path, but it will not swing for two minutes in the same path; hence, pendulums are all compelled to act in restrained paths, and generally supported on knife edges. French clocks have two strings of silk to the pendulum. These are fastened to two hooks at the top, and the pendulum rod being hung from the junction of the two silk cords, it is constrained to describe a path in a plane at right angles to that in which are the silk threads.

To return to the leaden vessel. It is now filled with fine white sand, and at the bottom there is an opening out of which the sand can trickle whilst the vessel swings freely. The figure caused by the sand falling on a board beneath will show the path that the vibrating body describes. It shall now be let go in what appears to be a straight line. If you watch that path you will see it is a very curious one. The sand at once indicates that the ends of the line are travelling round, also that the line itself is becoming wide in the middle. In fact a straight line is seldom formed by the falling sand from such pendulums. Even if a circular path be commenced, you will find it cannot be retained. It reminds one very much of one of the secular astronomical changes, that is, our year of 365 days and a fraction results from this gradual advance of the perihelion path of the orbit of the earth; observe it tends first to a straight line, then through an ellipse to a circle, and then a return action commences, and it will repeat this process from the straight line opening out again, and so pass on through various phases, until it comes to rest. Hence a pendulum constructed of a simple form is of no value, and yet it is in its simple form we require it. It was useful to assume for the purpose of the calculation that we can make a pendulum do that which this swinging vessel of sand is not doing.

Captain Kater was the first to deal with the case of converting the compound pendulum into a simple one. A pendulum is said to be a simple one when it consists of a heavy particle at the end of a very light thread. Such is almost an imaginary pendulum. All pendulums that we see are compound ones. Now, by pursuing the plan adopted by Captain Kater, he was able to obtain from the compound pendulum what would be the length of an equivalent simple pendulum. His pendulum has two pairs of knife-edges, a pair at the upper end, on which it swings, and a pair at the lower end. He placed one pair of these knife-edges on a smooth, hard surface, so that the pendulum might vibrate without anything causing it to continue its vibrations except the force of gravity. Now, if you look to this diagram, you will see the motions of a compound pendulum. If it were short it would move thus, and if it were longer it would move more slowly. The black dots in the diagram represent the lower ends of pendulums of different lengths. Assume that the black dots are the ends of separate pendulums, one behind the other, from the same support, they will then occupy those places after the same interval of time from rest; if, however, these pendulums are united, then the one is kept back by the action of the other; now they are really united in a compound pendulum. There is, however, some point or other at which, if all these masses were concentrated, the velocity at that point would be the velocity of the mass, therefore such a pendulum would vibrate in the same time, and it would be called a simple pendulum. Kater found that this collected point, which is called the centre of oscillation, and this at which the pendulum is suspended, are interchange-

able; in fact, he found that if the pendulum was accurately adjusted by means of these movable weights, he could suspend it upon a pair of the knife-edges, and he could get a certain number of vibrations in a minute or a second. Then, if he turned it upside down, assuming the pendulum to be right, and caused it to swing as before, upon the other pair of knife edges, it would make the same number of vibrations. Those two points he marked, and the distance between them is the length of an equivalent simple pendulum. With such a compound pendulum as now described, and of which the one before you is a copy, counting the number of vibrations it makes, you can always deduce the length of a simple pendulum that would make the same number of vibrations.

What Kater did, then, was this—he had a clock kept going, strictly to truth, that is, to true astronomical time. The clock was furnished with a gridiron pendulum of the construction shown in the diagram, and so carefully arranged as not to be altered in length in consequence of change of temperature. On the bob of the pendulum, in front, was a white speck, as on the pendulum bob of this clock. He placed the compound gravity pendulum, which has been described, in front of the clock, the clock pendulum beating 86,400 strokes per mean solar day. The rate of the clock was determined by astronomical observations, and therefore, on any part of the earth's surface, it would be possible to so arrange the solar pendulum that the clock should always record 86,400 beats in a mean solar day.

Now let us turn to this two-ended pendulum of Capt. Kater. It is of an invariable length, and acted upon directly by the force of gravity; there are no weights or clockwork in connection with it. When it is up on one side, it is the power of gravity that causes it to fall, and it is gravity which keeps it going. If, for example, a powerful magnet be placed under that pendulum, then it will come to rest sooner than it would otherwise do, because it is pulled down with greater force. If, therefore, gravity changes in its pull on this pendulum, it will tell on the rate of its vibrations. The rate of vibration of the equivalent simple pendulum is known, because it has been calculated from this compound one; hence, if this compound pendulum be placed in front of the clock keeping astronomical time, and if the vibrations of the pendulum be counted whilst the vibrations of the clock pendulum are being recorded, it might be ascertained whether the force of gravity varied in different places.

The means by which Kater compared these vibrations are very simple. You see the white speck, previously referred to, on the bob of this gridiron pendulum. He took a telescope, and placed it at some distance on a level with that white speck. Between the white speck and the telescope, and near to the gridiron pendulum, swung the gravity pendulum, which moved slower than the other, being made a little longer. Keeping his eye upon the telescope, and directed upon a narrow piece at the end of the gravity pendulum, which was the same width as the white circular speck upon the bob of the clock pendulum, he could tell when the two coincided. As one pendulum swung slower than the other, it was quite clear that a coincidence must take place, and he noted the time of the coincidence. That was the beginning of counting vibrations, and he then waited until they separated, and until the coincidence again took place a second time, which gave the number of the vibrations in a given time as recorded by the clock. Experiments like these were repeated very frequently and carefully, until at length the average was obtained as to the number of vibrations that this gravity pendulum made, compared with the vibration that the one on this mean solar clock made. Within the tube of this telescope there are crossings of very fine wires—so fine as to be hardly visible to unaided vision; the threads of a spider's web were formerly used for this purpose. A spider is taken in the fingers; then, if shaken,

he would run his web out to save himself, and this web was placed in the focus of the eye-piece, and the threads were so that the crossing of them was in the axial line of the telescope. It was by looking along that axial line that the time was observed when the coincidence of these two pendulum marks took place. The accuracy with which that was done is more easily to be imagined than realised.

Assuming that this has been accomplished, let us look for a moment to other elements which would disturb the result. In the first place, the pendulum vibrated in air; and you were told, in the first lecture, that a body weighed in air and weighed in any other medium is not balanced by the same weight. Hence, the effect of the air upon the pendulum has to be considered. Then the pendulum is vibrating in a changing atmosphere, sometimes warm, sometimes cold, and a change of the temperature causes an expansion or contraction, hence the effect of that expansion was to be considered. And, simple as it seems, to estimate whether a pendulum is longer or shorter is really very difficult. Indeed, great was Captain Kater's perplexity about it.

He measured the length of his pendulum thus:—He formed a box similar to the one on the table, and laid his pendulum in it, and applied a microscope over one of each pair of opposite knife-edges, placing behind them a piece of white paper, so that the edge might be seen. He then applied the microscope. Again, he put beneath them a piece of black paper, and he found that the measurement with the white paper was never the same as the measurement with the black paper. After describing how with microscopes he attempted to measure between knife-edge and knife-edge, by placing them when white on a black ground, and when black on a white ground, he added:—“In one case, the knife-edges seemed to start forward to each other.” This difficulty is summed up thus:—“On the cause of this extraordinary fact I can hazard no conjecture, and it remains an interesting subject for future investigation.”

We now know that this resulted from a phenomenon called “irradiation.” Hence he was bound, even in looking through those microscopes to strike an average of the apparent errors.

Another error that occurred, which he also found great difficulty in remedying, and indeed never did remedy, so that in fact the experiments he made are liable to some infinitesimal corrections still, was this:—If a pendulum vibrates, as this one was doing just now, the air clings to it, and is carried along with it, from what is called the “viscosity” of the air. That viscosity is such that, if you were to put a short piece of gold-leaf projecting edgewise upon the face of the pendulum bob, you would find that the gold-leaf moved with the action of the pendulum, and was carried along with it, so that it turned neither to one side nor the other. If, however, the gold-leaf projected beyond a certain distance, then you would find it bend with the air. Therefore, the atmosphere in immediate contact with the bob was dragged along with the pendulum, and that particular element Captain Kater was not aware of. Government, some years ago, in order to set this question at rest, had large vacuum chambers erected, and pendulums set vibrating in them, to ascertain how great an error was caused by the viscosity of the air.

Captain Kater having determined the length of this pendulum in the latitude of London in 1818, it was thought of great consequence to ascertain how great the force of gravity varied in different latitudes.

A memorial was presented to the Government in 1818, in order to ascertain by means of a pendulum how gravity varied throughout the British Isles, and Kater was commissioned to take steps for the purpose. Government placed at his disposal certain members of the Royal Corps of Engineers, with whom he set out to the north of Scotland, and made experiments at various places. He went up to Unst, in the Shetland Isles, then he came down to Portsoy, then to Leith, then down to Clifton, in Yorkshire, then to

Ashbury, then to London, and then to the Isle of Wight, and in each of those places he made certain experiments based upon the principles now too briefly described. This lecture would extend far beyond the allotted time if it entered into details with reference to local arrangements and special calculations. It may suffice to refer to the table for particulars of the results. The following is a copy of the table:—

Name of Place.	Latitude of Place.	Vibrations in a Mean Solar Day.	Length of a Pendulum to Vibrate Seconds.
	Deg. Min. Sec.		
Unst	61 45 28.20	86,066.90	39.17146
Portsey	57 40 58.65	86,086.05	39.16159
Leith Fort ..	55 58 40.80	86,079.40	39.15554
Clifton	53 27 43.12	86,068.90	39.14600
Ashbury Hill	52 12 53.32	86,065.05	39.14250
London	51 31 8.40	86,061.52	39.13829
Shanklin, or rather Dunmore ..	50 37 23.94	86,058.07	39.13614

From this table it will be seen that the length of a pendulum vibrating seconds in the places respectively entered is that given in the last column.

These lengths are sufficient to enable a mathematician to calculate the force by which the pendulum is caused to swing. Now, as the only force causing this swing is that of gravity, such a calculation determines the force of gravity at that place in relation to its power to produce motion. Hence is deduced those 39 inches, which, in ordinary expression, is thus broadly stated to be the length for pendulums vibrating seconds in the latitude of London. Captain Kater deduced that 39.13829 inches was the length of a pendulum vibrating seconds in Mr. Brown's house in London. This length requires to be reduced to sea-level. Now, the rooms of the Royal Society, at Somerset House, are 81 feet above low-water, and by the aid of a mountain barometer, made by Ramsden, Kater found the room in Portland Place to be 2 feet below those of the Royal Society, and, as the length of pendulum above the floor was 4 feet, the elevation of pendulum above sea-level is 83 feet.* Now, gravity varies inversely as the square of the distance of the place from the centre of the earth; therefore, the length of pendulum must be increased in this proportion; and, taking the radius of the earth for the latitude of Portland Place to be 3954.583 miles, we have 39.1386 inches for pendulum vibrating seconds at the level of the sea in the latitude of London.

The greatest difference between the mean and that of any of the sets of experiments is only 0.00028 of an inch, or $\frac{1}{354,122}$ of length of pendulum. The length 39.1386, as thus determined, is that required to perform one vibration, in $\frac{86,066}{24}$ of a mean solar day, under the circumstances described, and at the level of the sea.

Finding how much could be obtained from this with regard to the British Isles, Government commissioned Captain Sabine to go to different places on the east coast of Africa, the Island of Ascension, Bahia, Trinidad, Jamaica, New York, Greenland, and Hammersfest, in Norway, and repeat Captain Kater's experiments. These experiments are repeated, and then, by an arithmetical process which need not be referred to in detail, it was very easy, having given the number of vibrations of this invariable pendulum (for the distance between these knife-edges did not vary) performed in a solar day, to calculate the power that was pulling it; and from that calculated power could be obtained the mass of the earth beneath the place where it was being pulled, making, of course, all the allowances for corrections and other circumstances. That calculated power gives the 32 feet which we are all acquainted with as the measurement of gravity. The meaning of which is, that gravity will generate in a 1-lb. weight, in one second, a velocity thirty-two times greater than that which it is agreed shall be called

* This is necessary to conclude that these measurements require to be corrected.—A. R.

the unit or absolute measure of force. Put conversely, the absolute unit of force is equal to the weight of 16 oz.

$\frac{32 \cdot 2}{16} = 1$ oz. nearly.

Captain Foster afterwards repeated these experiments, and made others, and from them has been obtained the figure of the earth, and calculations of all kinds used in scientific investigations throughout the globe depend upon them. Captain Foster was unfortunately drowned in the river while observing some of his experiments, but Mr. Bailey undertook to tabulate his results, and completed the calculations on the data which had been obtained by Captain Foster's observations. The calculations Mr. Bailey made for this purpose occupy many closely-printed quarto pages of figures. The result was solely to ascertain the length of the pendulum, and so deduce the figure of the earth. Great beyond all ordinary estimate is the amount of care, patience, perseverance, and anxiety that attends experiments of this kind.

(To be continued.)

NOTICES OF BOOKS.

Plattner's Manual of Qualitative and Quantitative Analysis with the Blowpipe. From the last German edition, revised and enlarged. By Prof. TH. RICHTER, of the Royal Saxon Mining Academy. Translated by HENRY B. CORNWALL, A.M., Assistant in the Columbia College School of Mines, New York, and JOHN H. CASWELL. Second Edition, revised. New York: D. Van Nostrand.

It would be utterly superfluous on our part to express any opinion on a work which has won so high a reputation as the great masterpiece of the late illustrious Professor of Freyberg. The present version is founded on the latest German edition, enriched with the valuable additions of Professor Richter. Among the improvements we notice the introduction of no fewer than 150 new minerals, a quantitative test for mercury, the description of new apparatus for measuring silver assay buttons; and an elaborate index in three divisions—one for minerals, another for metallurgical products, and the third general. The instructions for the quantitative determination of bismuth, cobalt, nickel, iron, and for the examination of coal, have also been added since the appearance of the former English translation from the pen of the late Dr. Sheridan Muspratt. The reader will be enabled to compare the two versions when we state that Dr. Muspratt's has only 392 pages exclusive of index, while Mr. Cornwall's extends to 522, and is more compactly printed. The editor appears to have carefully and conscientiously discharged his duties. The retention of the old Berzelian formulae, in which oxygen is expressed by dots, and sulphur by commas placed above the symbols of the other elements, may seem strange to some readers, but it is not without advantages in mineralogical matters. We cannot in passing refrain from protesting against an expression which has caught our attention. To be told that—"copper occurs quite extensively in nature," grates on the ears of all who have been accustomed to precision of thought and language. As the latest and best English version of Plattner this book will be indispensable to all students of mineral chemistry and its applications.

Observations on the Agricultural Chemistry of the Sugar Cane. By T. L. PHIPPS, Ph.D., F.C.S. London: Ranken and Co.

WHAT may be called the stereotyped orthodoxy of agricultural chemistry receives from time to time very severe shocks. But a few years ago we were taught that the sole duty of the chemical manure maker was to offer his customers abundance of phosphoric acid in a soluble form, and of nitrogen—though the importance of the latter was

not universally conceded. Now we learn alike from scientific research and from practical experience that a plot of land may become exhausted of other constituents as well as of phosphates and combined nitrogen, and that in such cases superphosphates and ammoniacal salts are useless. This truth is ably enforced by Dr. Phipson, not merely as regards the sugar-cane, but for crops in general. He points out that the substances added to a soil must not only be sufficient in quantity and right in kind, but must also be in an assimilable condition if the plants are to be benefited. Liebig showed that by burning a plant to ashes, and analysing the result, we learn the food necessary to render it luxuriant in a given soil. But if we burn a quantity of wheat-plants to ashes, and apply this residue as manure to a fresh plot of land sown with wheat, the crop proves a failure. The author states—"The burning of a vegetable to procure the ash renders the mineral food it naturally contains almost useless as manure." On superphosphate employed as a sugar-cane manure he places little reliance. Ammoniacal salts have been largely tried in Demerara; the result being the rapid growth of the canes, and the production of a juice poor in sugar. A very important fact to which the author calls attention is that the analyses of the mineral ingredients of plants, incinerated after they arrive at maturity, must coincide, and "can alone teach us accurately what any plant takes from the soil." Dr. Phipson was once called to report upon a number of analyses of sugar-cane, executed by chemists of admitted skill, but which nevertheless presented serious discrepancies. After a long investigation he found that the samples of cane had been taken at various stages of growth, and the results consequently could not coincide. On the other hand, an analysis of some ripe coffee berries from Ceylon coincided most closely with one made thirty years ago with West-Indian coffee. This is an apt illustration of the old, but not stale, truth that analyses of organic substances except made under distinctly defined circumstances are merely a waste of time. The author finds that the sugar-cane withdraws lime from the soil more rapidly than magnesia. Hence, "the degree of exhaustion which a cane soil has undergone can, to a great extent, be ascertained by comparing the relative amounts of lime and magnesia" found on analysis. The deficiency of humus—an article not long ago proclaimed of little value—is found in Java to be a source of sterility, "by causing a want of porosity, of nitrogen, and of carbonic acid." In this country every nurseryman and market gardener knows the importance of humus, however unable he may be to point out its exact mode of action. The most important portion of Dr. Phipson's pamphlet is where he shows the value of farmyard manure, night-soil, and similar residues as containing not merely "all that the plant requires," but also "in the proper state for assimilation." This truth has of late been forcing itself, from various points of view, upon the attention of agricultural chemists. Manures made from excrementitious and sewage matters, though poor in the two fashionable items of phosphoric acid and ammonia, are yet found in practice to give better results than some which "analyse well." Dr. Phipson's pamphlet is, in short, highly suggestive, and whilst we cannot approve of all it contains—e.g., the laudatory mention of certain firms in the manure trade—we have much pleasure in recommending it to our readers.

The Retrospect of Medicine. Edited by W. BRAITHWAITE, M.D., and JAMES BRAITHWAITE, M.D. Vol. lxviii, Jan. to June, 1873. London: Simpkin, Marshall, and Co.

This volume, subdivided into sections on practical medicine, surgery, midwifery, &c., contains little matter directly connected with chemical science. We notice certain particulars on a recent outbreak of enteric fever at Nunney, in Somersetshire. The disease is distinctly

shown to have been introduced by the evacuations of an individual attacked finding their way into a small stream which supplied the village with water. With the introduction of a supply of uncontaminated water the number of fresh cases fell, from eight to thirteen weekly, to five; and in the subsequent week to one. Dr. B. W. Richardson gives an account of his last new anæsthetic methylen ether, which he considers safer than chloroform or methylen bichloride, whilst possessing all their advantages. That vexed question—the therapeutic use of electricity—is also discussed at some length.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopaedic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, July 21, 1873.

Third Notice on Guano.—M. Chevreul.—The author examines into the cause of the development of carbonic acid gas when the hard portions of the guano come in contact with water, and announces his intention of examining under what circumstances carbonate of ammonia behaves in this manner.

On Nitrification in Soils.—M. Th. Schlœssing.—The author finds that the quantity of nitric acid produced is not proportional to the amount of oxygen contained in the air, the relation between these two quantities—the amount of nitric acid produced, and the proportion of oxygen contained in the air, being very complicated. When the proportion of oxygen in the air does not exceed 14 per cent, the amount of nitric acid produced is even then very considerable. The arable soils almost entirely separate the oxygen from the other gases present in the atmosphere. As the proportion of oxygen augments the yield of nitric acid is increased, and seems to attain its maximum when the oxygen is about 16 per cent; beyond which it decreases in proportion to the increase of the oxygen. These experiments seem to prove that the free nitrogen and oxygen of the air take a direct part in the formation of nitrates. The soil used by the author in his experiments was rich in humus and in lime. All carbonic acid and ammonia pre-existing in the atmospheres operated upon had been previously eliminated.

On a Compound of Picric Acid and Anhydrous Acetic Acid.—D. Tommasi and H. David.—The formula of the new compound is—



It may be regarded as a picrate in which 1 atom of metal is replaced by acetyl. It melts between 75° and 76°, begins to decompose at 120°, turns brown at 180°, and is completely decomposed at 260°, leaving a carbonaceous residue. Alkaline solutions split it up in the cold into acetic and picric acids. It does not detonate on percussion, but if mixed with chlorate of potassa it explodes with violence.

Action of Pyrogallic Acid upon Iodic Acid.—M. Jacquemin.—Pyrogallic acid placed in contact with iodates turns brown instantly. The reaction is the same whether the iodic acid be free or combined. Bromic and chloric acids have no such action, except the latter is concentrated enough to ignite paper; whilst iodic acid acts energetically even when diluted with 250 parts of water. Hence, pyro-

gallic acid may serve as a reagent to indicate the presence of iodates occurring as impurities in a commercial sample of iodide of potassium.

On a Native Compound of Oxides of Iron and Copper, and on the Artificial Formation of Atakamite.—C. Friedel.—This new mineral—delafossite—is found at Katharinenburg, Perm, Russia, accompanying laminary graphite. Its composition is—

Sesquioxide of iron	.. ..	47.99
Alumina	.. ..	3.52
Suboxide of copper	.. ..	47.45

98.96

Its sp. gr. is 5.07; its hardness 2.5. It yields a greyish black powder, and is opaque even in the thinnest laminae. Atakamite was artificially produced by heating a solution of ferric chloride with cuprous oxide to 250° for eighteen hours in a sealed tube. Brilliant green crystals were deposited on the sides of the tube, agreeing in form and properties with atakamite.

On Spontaneous Alterations in Eggs.—U. Gayon.—The author finds that the putrefaction of eggs is correlative with the multiplication of vibrios, and is not in all cases accelerated by shaking and mixing up the white and the yolk. Mouldiness may also set in—which is not to be confounded with putrefaction—and is caused not by bacteria or vibrios, but by vegetable spores. In another and rarer change the egg gives off a peculiar acid smell without putridity, having an acid reaction, and containing alcoholic products. In this case no bacterial germs are present.

Note Concerning the Change of Velocity of Regime in Isochronous Regulators.—M. Y. von Villarcieu.—The author here discusses the case of a temporary change; as where, after observing stars with an equatorial, one wishes to observe a planet, a comet, &c., and it is desirable to be able to alter the instrument quickly. He mounts the axis of the regulator in a movable frame, so that one may give it any inclination to the vertical. He investigates the mode of action of an isochronous regulator with the axis inclined.

New Researches Confirming the Localisation in the Cerebellum of the Co-ordinating Power of Movements Necessary to Walking, Standing, and Equilibration.—M. Doulland.—The author has been led to this result by experiments on some thirty animals of different species, and by clinical observation. He doubts Flourens' doctrine that the cerebellum co-ordinates all the voluntary movements of translation and prehension. Further, in place of holding that the brain co-ordinates none of the voluntary movements of translation and prehension, he holds that it co-ordinates a great number of them, but not those of walking and standing.

Direct Demonstration of the Fundamental Principles of Thermo-Dynamics; Laws of Friction and Impact according to this Science.—Continued extract from memoir by M. Lédien.—The writer here establishes some formulae, and gives some explanations relative to motion and velocity in a system of material points.

Movement of a Spherical Segment on an Inclined Plane.—Extract from memoir by Gen. Didion.

Spectra of Iron and some other Metals.—P. Secchi.—He wished to ascertain whether the line 1474 K, seen in the corona of eclipses really belonged to iron, as has been asserted. Fifty Bunsen couples were used, giving a powerful force. The voltaic arc of iron was got in various ways:—(1) With two iron cones; (2) with one at the positive pole, and a carbon cone at the negative; (3) with drops of iron in a little hollow of a carbon point forming positive pole. He used a direct-vision spectroscopic, and with a heliostat reflecting the sun's rays between the electric poles he could have the solar spectrum and that of the electric arc superposed. He examined carefully the lines in the superposed spectra, and also those in the

iron spectra alone; also tried various kinds of iron, but in no case did the line in question appear; and he concludes, that if it belongs to iron, it is developed in circumstances of temperature still unknown. He makes some further remarks on the spectrum of the arc from the carbon points which, projected on a white screen with a Dubosq apparatus, had a size of about 10 centimetres, so that its different parts could be well examined separately. He notes some differences from what Morren and others have observed in the carbon vapour spectrum. Experimenting as to whether any other metals gave the finely faded spectrum of carbon, he found that aluminium gave it admirably.

Permeability of the Sand at Fontainebleau.—M. Belgrand.

Experiments on the Movement of Swell Produced in an Artificial Channel, making the Water Rise on an Inclined Plane to a Height Sensibly Constant.—M. de Caligny.—The writer's design is to show the advantage, for study of waves, of isolating a phenomenon in an artificial channel. The experiments made were of a rough and preliminary character.

Letter from M. Nordenskiöld, from Mossel Bay (lat. 79° 54' N.), where the Expedition passed the Winter.—Among other interesting facts it is stated that Lieut. Parent and Dr. Wykander had been studying the aurora and its spectrum with an excellent apparatus, and had determined seven different spectral lines; which Dr. Wykander thinks are exactly the spectrum of the lower part of the flame of a candle or of a petroleum lamp. This seems to indicate some relation between the aurora and the fall of cosmic dust containing carbon, hydrogen, metallic iron, along with snow (as described in a previous letter). It may explain anomalies observed in auroral spectra in different places and at different times. The vegetation of Algæ seems to attain a maximum in the darkness and cold of an Arctic winter. The botanist considers they can live without light, and at a temperature of -2° C. The photographer found that a sensitised plate kept twelve hours on the sea bottom, where Algæ were flourishing, underwent no change. In walking along near the coast one observes a bright luminous trace on the snow. This is produced by myriads of small crustacea at a temperature of -10° C.

On some Matters Suited for the Destruction of Phylloxera.—M. Petit.—These are coal-tar, ammoniacal water, and the lime from gas refineries.

New Spectral Observations which are in Discord with some Theories of Solar Spots.—M. Tacchini.—The author followed the progress of faculae giving a metallic spectrum (and attesting eruption) throughout a whole semi-rotation, but found no spot appear. This, in his view, increases the difficulties of both P. Secchi's and M. Faye's theories. On the former theory every eruption should give a spot; and on the latter a metallic spectrum should only be observable in case of a cyclone, i.e., a solar spot. The present observation proves the contrary. M. Tacchini further states that he had observed in a solar region an eruption extending over nearly 50° of latitude, and not terminating for seven days; during which time magnesium and Kirchhoff's line 1474 were always visible on the entire border of the sun. Here, then, is a general movement in the upper layers of the sun, independent of the movement of rotation.

Researches on Electrical Condensation.—M. Neyreneuf.—The following conclusions are arrived at:—(1) The constancy of charge of the ordinary electrophorus is due to imperfect contact; (2) The employment of a proof plane is quite defective for quantitative and even qualitative researches as to the electrification of an insulating plate; (3) the employment of a gold-leaf electroscope requires great precaution, because of the variable state arising from the action of the insulating plate of a condenser as electrophorus; (4) an electrophorus placed

in the best theoretical conditions would hardly give any effect, because of the antagonism of spontaneous discharges, and those obtained by ordinary action of the apparatus.

Annalen der Chemie und Pharmacie, band clxviii., heft 1. (Neue Reihe, band xcii., heft 1.)

On Azophenylene.—Prof. A. Claus.—This substance, obtained by the dry distillation of the azobenzoate of lime, consists of—

Carbon	79.12
Hydrogen	5.49
Nitrogen	15.38

99.99

and may be expressed by the formula $C_{12}H_8N_2$. It forms long, light yellow, shining needles, which melt at 170° to 171° and sublime unchanged at higher temperatures. It dissolves in about 50 parts of cold alcohol, but readily in the same liquid when hot. It is very sparingly soluble in water, and crystallises unchanged from these solvents. It is volatilised along with the vapour of boiling water, to which it gives a pleasant aromatic odour resembling that of the oil of cinnamon. In hydrochloric acid it dissolves unchanged and may be re-crystallised from the solution. Nitric acid converts it into a nitro product which separates out in brown, flocculent, crystalline masses. On prolonged heating with concentrated sulphuric acid it is converted into a sulpho acid. The author has formed and examined bromazophenylene, $C_{12}H_5N_2Br$, hydrazophenylene, $C_{12}H_{10}N_2$, and the combinations of the latter with sulphuric and hydrochloric acids, and with platinum. The paper concludes with a lengthy hypothetical disertation.

On Di-Iodhydrin.—Prof. A. Claus.—Di-iodhydrin is a pale yellow thick oil, of the sp. gr. 2.4 at a temperature of 15° . At -16° to 20° it congeals to a colourless crystalline mass. Its formula is $C_2H_4I_2O$.

Action of Ammonia upon Dichlorhydrin.—Prof. A. Claus.—If dichlorhydrin is heated with alcoholic ammonia to 105° in a sealed tube, one of the products is an amorphous gelatinous body—chlorhydrinimid,— $C_{12}H_{17}N_3Cl_2O_4$.

It is a white body, insoluble in water, alcohol, ether, and even in concentrated acids. If the alcoholic ammonia is very weak there are produced—instead of chlorhydrinimid—two new bases, diamidohydrin and glycidamin.

Preparation of Dichlorhydrin.—Prof. A. Claus.—About 800 grms. of glycerine (concentrated till its boiling-point is 195°) are placed in a flask holding 2 litres, and 2 kilos. of chloride of sulphur are gradually added with constant stirring, whilst the whole is heated in a bath of common salt. The flask is fitted up with a cobabation tube, which is removed after the heat has been applied for 7 to 8 hours in order to drive off the sulphurous and hydrochloric acids. When the mass is cool 2 or 3 volumes of ether are added, the deposit of sulphur is filtered off, the ether is distilled off in the water-bath, and the residue submitted to distillation over the open fire. After thrice repeated redification pure dichlorhydrin is obtained, boiling at 178° .

Applicability of the Periodic Law to the Metals of the Cerium Group.—D. Mendeleeff.—A controversial paper in reply to Rammelsberg. (See *Ber. d. Deut. Chem. Gesells.*, 6, 84.)

Preparation of Ethylene and Ethylene-Bromide.—E. Erlenmeyer and H. Bunt.—This paper would not be intelligible without the accompanying diagram.

Action of Nascent Hydrogen upon the Oil of Bitter Almonds.—Hugo Ammann.—The author examines hydrobenzoin and its behaviour with chloracetyl and chloride of phosphorus; also isohydrobenzoin, which, as well as hydrobenzoin, is formed by the action of sodium

amalgam upon the oil of bitter almonds, and its behaviour with the same reagents.

On Bromised Benzol Sulpho Acids.—Adolph Woel.—This paper gives an account of dibrombenzol-sulpho acid, and its barium, calcium, potassium, ammonium, copper, and lead salts; its behaviour with melting hydrate of potassa; experiments on the preparation of benzotricyanide and benzol-tricarboxylic acid; monobrombenzol-sulpho acid and its transformation into benzol-dicarboxylic acid.

Investigations on the Constitution of Piperin, and its "Splitting up" Products, Piperic Acid, and Piperidin.—Rud. Fittig and Ira Remsen.—This paper treats of the synthesis of piperonylic acid, and of a new mode of formation of protocatechuic acid aldehyd.

On Ethylen-Protocatechuic Acid.—Rud. Fittig and Thomas Macalpine.—The formula of this acid was ascertained to be $C_9H_8O_4$. The authors examine its calcium, barium, and sodium salts; its ethylic ether; its decomposition when heated with dilute hydrochloric acid; its behaviour with chloride of phosphorus, dichlorhydrin-protocatechuic acid being the result; its preparation from carbo-hydrochloric acid, which latter the authors consider completely identical with protocatechuic acid.

Some New Compounds of the Naphthalin Group. J. P. Battershall.—The author's object was to find in the naphthalin group representatives of the aldehyds and the true alcohols. He succeeds in obtaining and examining isonaphtho aldehyd, $C_{10}H_7CHO$; hydroisonaphthamide, $(C_{10}H_7CH_2)_2N_2$; two isomeric acids α and β sulphonaphthoic acids and the barium, calcium, potassium, and copper salts of the former; oxynaphthoic acid; sulphoisonaphthoic acid with its barium salt; and oxysynaphthoic acid.

On a Change in Cast-Iron Produced by the Action of a Mineral Sulphur Water.—Dr. E. Priwoznik.—An iron water-pipe which had been exposed for twelve years to the action of water rich in the sulphide of hydrogen was examined. The innermost stratum consisted of—

Hydrated oxide of iron	81.08
Free sulphur	12.29
Sulphide of iron	4.48
Hygroscopic water	0.57
Nickel, cobalt, magnesia, silicic acid (soluble and insoluble), traces of carbon, and chlorides of ammonium and sodium ..	1.58

100.00

This stratum is, therefore, an intimate mixture of hydrated oxide of iron, sulphide of iron, and sulphur. The hydrated oxide has the composition $2Fe_2O_3 \cdot 3H_2O$, and is therefore identical with limonite. The middle stratum contained 79.2 per cent of metallic iron, and the exterior 92.6.

On Sulph-Hydantoin (Glycolyl-Sulphurea).—Richard Maly.—The author obtains monochloracetyl-sulphurea by the mutual reaction of monochloracetic acid and sulphocarbamid. From this product sulphhydantoin is readily obtained.

Determination of the Boiling-Point of Liquids at a Normal Atmospheric Pressure of 760 m.m.—Dr. H. Bunt.—The author has devised an apparatus for dispensing with correction for the varying barometric pressure.

Preparation of Trimethyl-Carbinol by the Method of Linnemann.—A. Butters.—The author criticises Linnemann's process, and seeks for an explanation of the details necessary for success.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, July 14, 1873.

On a New Deposit of Struvite.—Robert Otto.—In pulling down a house in the Knochenhauer Strasse, in

Brunswick, there was found about seven feet below the level of the pavement a stratum of decomposed excrement several feet thick, and interspersed with crystals which, according to their chemical and physical properties, consist of struvite.

Chemical Composition of Vesuvian.—C. Rammelsberg.—Former researches seemed to show that the composition of garnet and vesuvian were identical—a result confirmed upon the whole by the experiments of Magnus. The more recent analyses of the author, as well as those of Hermann and Scheerer, indicated the general formula, $R_8R_3Si_2O_{60}$. Magnus found that the vesuvian of Wilni lost 0.7 per cent on ignition; the author showed that in all other cases this loss amounted to 2 to 3 per cent, and consisted of water. The yellow and brown vesuvian of Mongoni, the vesuvians of Ala, Zermatt, Haslan, and Wilni were re-examined. In all, $R:Si=1:3.5$; in all except that of Wilni, $R:R=1:4$, and $(H,K):R=1:2.66$; in that of Wilni, $R:R=1:4.5$, and $(H,K):R=1:9$. Hence, for the majority, the formula is $H_3R_8R_3Si_2$, and for that of Wilni $H_2R_8R_3Si_2$.

On Certain Derivatives of Normal Propyl Alcohol.—H. Roemer.—The author has prepared and examined the mercaptan, C_3H_7SH ; a mercaptid, $(C_3H_7S)_2Hg$; the propyl-xanthogenate of potassa, a tripropyl-biuret, —
 $CON(C_3H_7)_3CONH_2$;

tetra-propyl-ammonium-iodide, and tetra-propyl-ammonium-oxhydrohydrate.

On Pyruvic Acid.—C. Böttinger.—The author had previously shown that during the transformation of pyruvic acid into utivinic acid, the intermediate product hydrovinic acid is concerned. More recently he has prepared large quantities of pyruvic acid to examine in detail the transformation of basic hydrovinic acid of baryta, and especially to examine the residual syrupy acid named by Tinkle utivonic acid.

On Chlortoluols.—H. Hübner and W. Majert.—The authors have formed and examined the ortho-chlortoluol sulphates of baryta, lime, lead, potash, soda, copper, copper-ammonia, and ammonia; the acid ortho-chlortoluol-sulphobenzates of potash, baryta, and lead; the metaluol sulphates of baryta and lead; the β -parachlortoluol sulphates of baryta, lime, lead, potash, copper, and copper-ammonia; and the α -para-chlortoluol sulphates of baryta and soda.

On Amido-Benzol, and a Simple Preparation of Meta-Diamidobenzol.—H. Hübner and H. Retschy.—If two constituents differing from hydrogen are introduced into benzol two pairs of compounds will be derivable, which may possibly be only distinguished by the manner of the combination of the atoms of carbon. With this purpose the authors examine diamidobenzol.

On Isomeric Brom-Toluidines.—H. Hübner and P. E. Roos.—The authors have found and examined a parambromit compound, and obtained by amidising it α -parambromitoidin, and certain of its salts.

On Meta-bromtoluol.—H. Hübner and E. A. Grete.—The authors dissolved meta-bromtoluol in fuming sulphuric acid, and examined its barium salt.

On Benzyl-Dichloride Simultaneously Treated with Chlorine and Nitric Acid.—H. Hübner and F. Bente.—One of the authors had on a former occasion begun to examine the question whether all elements or groups of a decidedly homologous character, whether decidedly chemico-negative (acid) or chemico-positive (basic), replace the same atom of hydrogen in hydrocarbons. In the majority of cases the behaviour of such bodies was found to be absolutely identical. Certain exceptions, however, became apparent. Thus Beilstein and Kuhlberg observed that benzyl-dichloride with chlorine yields para-chlor-benzyl dichloride, $C_6H_4Cl_2CH_2Cl$, and, on oxidation, para-chlor-benzoic acid, whilst benzyl dichloride with nitric acid yields a nitro-compound, which, on oxidation, gives meta-nitro-benzoic acid, instead of

para-nitro-benzoic acid as might be expected. This subject the authors have further examined.

Absorption of Ozone in Water.—L. Carius.—The author has previously shown that ozone can be absorbed by water unchanged in quantities not considerable. He now finds that at the temperature 0° , and a pressure of 0.76 m.m., 1.346 c.c. of ozone were absorbed by 100 c.c. of water; this is independent of the amount of oxygen absorbed. The ozone used in these experiments was obtained by electric action.

Relative Position of the Lateral Links in Zincke's Hydrocarbons.—Br. Radziszewski.—A purely theoretical, or rather hypothetical, paper.

Remarks on the Structure of Aromatic Bodies.—Br. Radziszewski.—The same remark applies to this paper.

On Aromatic Phosphorus Compounds.—A. Michælis.—The author has examined—Phosphényl chloride, phosphényl tetrachloride, phosphényl chlorobromide, phosphényl chlorotetrabromide, phosphényl oxychloride, and phosphénylic acid.

On Steam Press Filters.—Arnold Heintz.—The apparatus described is ingenious, and will probably be useful. The description would be unintelligible without the accompanying diagram.

MISCELLANEOUS.

The Adulteration Act.—The Board of Works for the district of Greenwich has just complied with the requirements of the Local Government Board in appointing a public analyst, under the provisions of the Adulteration Act. Out of seven candidates for the appointment, at the meeting of the Board on Wednesday, Mr. Wigner, of 79, Great Tower Street, public analyst for Plumstead district, was chosen.

To Fasten Leather upon Metal.—F. Sieburger recommends the process proposed by the late Prof. Fuchs:—One part of crushed nutgalls is digested six hours with eight parts distilled water, and strained. Glue is macerated in its own weight of water for twenty-four hours, and then dissolved. The warm infusion of galls is spread upon the leather, the glue solution upon the roughened surface of the warm metal, the moist leather is pressed upon it and then dried, when it adheres so that it cannot be removed without tearing.—*Polyt. Notizbl.*

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in treating certain gases for lighting and heating purposes, and in combining atmospheric air therewith. Charles Weighman Harrison, High Holborn, Middlesex. January 1, 1873.—No. 1. The novelty of this invention consists in carbureting or increasing the proportion of carbon in hydrocarbon gases, such as coal-gas, and afterwards mixing or combining therewith atmospheric air.

Improvements in apparatus employed in the manufacture of salt. Otto Ernest Pohl, salt manufacturer and merchant, Liverpool. January 1, 1873.—No. 4. This relates to evaporating apparatus in which the flames or heating gases are passed between two pans, and consists in covering the top of the bottom pan with sheet-iron or other material, preferably formed channelled when viewed in transverse section. The bottom pan is made wider than the top one, to allow rakes to be conveniently used.

Improvements in treating waste products and other materials containing zinc for the purpose of recovering zinc and other valuable products therefrom, and in apparatus to be employed for that purpose. Charles Roundy, metal broker, Birmingham. January 1, 1873.—No. 12. According to 12 is invention the waste product or material, consisting principally either of old zinc, new zinc cuttings, or zinc riddings from galvanisers' ashes, is placed upon the top of an incline, forming the bed of a muffle or nearly closed chamber, and heated so as to sweat from out of it the zinc, which zinc runs down the said incline, being carried with it any lead which may be contained in the material, and also solid particles of foreign matters. The liquid metal collects in the first of a set of receivers situated at the bottom of the bed. In the first receiver a large portion of the solid matter carried with the metal falls to the bottom. The metal in this receiver is removed from time to time, the upper part being poured back, and

the lower part being cast into ingots and treated again. As the first receiver becomes filled, the zinc overflows into the next receiver, and so on, where a spontaneous separation of the kind described takes place. The separated and purified zinc finally collects in a large pan or reservoir, and may be cast into ingots or otherwise. Before treating the riddings from galvanizers' ashes by the process described, they undergo a preliminary treatment for the purpose of utilising the ammoniac and oxide of zinc contained in the said ashes.

Improvements in the manufacture of paints. William Britton Stevens, 67, Strand, Westminster. January 3, 1873.—No. 35. The application and use of slaked lime or plaster of Paris, one or the other, or both, instead of, or in combination with, the usual bases employed in the manufacture of paint.

Improvements in the filtration of water, and in the means and apparatus employed for that purpose. Gustav Bischof, Professor of Technical Chemistry, Andersonian University, Glasgow. January 3, 1873.—No. 36. This invention has reference to the process of purifying water by filtering it through spongy iron. In January 1, 1873, one of the 1870 were granted to the petitioner. The present invention consists in causing the water to filter through marble or limestone after passing through the spongy iron in order to remove the iron taken up by the water. Filters for this purpose are described, consisting of a vessel with perforated bottom containing the spongy iron, placed above a vessel with perforated bottom containing the marble or limestone, and arrangements are described whereby the water, after filtering through the spongy iron, is made to rise to the level of the spongy iron again before flowing down on to the marble or limestone, in order to keep the spongy iron always immersed. Animal charcoal may also be employed in place of the marble or limestone for retaining the iron. An improved process and apparatus for extracting oleaginous or fatty matters from liquid or solid substances. William Gordon Thompson, manufacturing chemist, Manchester. January 3, 1873.—No. 42. The object of this invention is to separate oleaginous and fatty matters from various substances with which they may be combined, so that such oily or fatty matters when separated may be applied for various purposes in the arts.

Improvements in means or apparatus for the distillation of ammoniacal liquors, which improvements are also applicable in the distillation of other liquids, and in the concentration of soluble salts. Alexander Angus Croll, civil engineer, Coleman Street, London. January 4, 1873.—No. 45. The invention relates to means by which the liquid matter to be acted upon is received into the upper of a series of evaporating trays or chambers, and is then allowed to flow down to the next tray and thence to each in succession until it arrives at the lowest, which is that immediately over and surrounding the fire. The heat from the fire passes up through the centre of the lower chamber, thence radially over the liquor in that chamber, and under the chamber next above, and thence under and over each to the outlet. The fire-door of the furnace is sealed after the supply of each charge, to cause all the atmospheric air to pass through the fire, and such air is forced upwards or upwards where the vapour has to pass through another media, as in the manufacture of sulphate of ammonia, or it may be drawn by vacuum.

Improvements in obtaining valuable substances derivable from residual liquors produced in the manufacture of alum from phosphates of ammonia. Peter Spence, manufacturing chemist, Newton Heath, Manchester. January 4, 1873.—No. 50. This invention refers to obtaining valuable substances from the liquor arising from the manufacture of alum by the process patented by the present inventor dated June 9, 1870, No. 1676.

NOTES AND QUERIES.

Pure Anthracene.—Could any of readers kindly inform me of any accurate method of estimating the amount of pure anthracene in crude anthracene. I have tried one or two methods considered to be the most accurate, but these give far from good results. I shall feel greatly obliged to anyone who can favour me with an answer.—W. G. F.

Carbolic Soap.—I would be obliged if you readers could give me any information about the manufacture of carbolic soap used for sheep-washing. I believe it is made from soft soap and carbolic acid; I should like to know how the two ingredients are mixed together, in what quantity, the strength of the carbolic acid to be used, and how much to be used for washing each sheep, and if it is a cure for the scab in sheep.—B. WOTTON.

TO CORRESPONDENTS.

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J. G. F.—Our "Students' Number," which will be published early next month, will contain full information respecting the examinations for B.Sc. and D.Sc. degrees.

H. F.—We do not know the composition of "Oroide of Gold" or "Persian Silver."

G. A.—Your communication does not contain sufficient poverty to warrant its insertion.

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THE CHEMICAL NEWS.

VOL. XXVIII. No. 717.

THE CHEMICAL CONSTITUTION OF SUCCINIC, MALIC, AND TARTARIC ACIDS, CRITICALLY EXAMINED AND INTERPRETED FROM THE STAND-POINT OF THE "TYPO-NUCLEUS" THEORY.

By OTTO RICHTER, Ph.D.

(Continued from p. 77).

PART II.

On the Principal Molecular Changes which the Water-Salts of Succinic, Malic, and Tartaric Acids are prone to experience under the influence of Heat and Oxidising Agents.

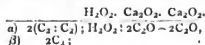
This part may be conveniently divided into two chapters, the one to treat on the effects of heat, and the other on the effects of oxidising agents, upon these compounds.

CHAPTER I.

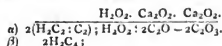
On the Effects of Heat upon the Water-Salts of Succinic, Malic, and Tartaric Acids.

(1). Let us, in the first place, contemplate the effects of temperature when the ordinary succinate is mixed with hydrate of lime. On treating the resulting lime-salts with hydrochloric acid, carbonic acid is given off, and a substance is found in the distillate which, in composition and properties, agrees with the normal propionate of water. In musing upon the nature of this evidently very complicated reaction, I soon came to comprehend that its course must be marked by a number of well-defined transition products—among others, by the occurrence of two isomeric modifications of the succinate. One of these isomerides, to which I will apply the term "iso-succinate," is no doubt identical with a compound realised some time ago by boiling one of the two varieties of cyan-propionate with potash ley (*vide* Part III.); while the other, to which I will apply the term "para-succinate," remains yet to be discovered. The rationale of the entire process may be given in the following words:—

In the first stage, the succinate of lime splits up into 2 molecules of water, derived from the formylic alcohol ally and the unknown succinate of lime—

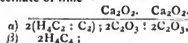


whose formula implies that the liberated formen has coalesced with the formen adjunct of the unaltered principal under the double form of biformen or deacetylen. At the same time the two liberated water molecules become decomposed, so as to yield up their oxygen to the oxalous acid ally, while their hydrogen unites with the biformen or deacetylen adjunct. The resulting product is, therefore, a molecule of iso-succinate of lime—



In the second stage, the colligated methylen-formylic or acetylic alcohol breaks up into 2 molecules of water and the corresponding hydrocarbon, which instantly re-unites as adjunct with the oxalous acid principal; at the same time the two liberated water molecules suffer decomposition, so as to yield up their oxygen to that principal, while their hydrogen unites with its freshly acquired

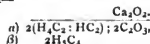
hydrocarbon adjunct. The resulting product is, therefore, the para-succinate of lime—



with methan-formen or ethylen for an adjunct.

Before proceeding farther, it behoves me to state that this latter isomeride differs materially from its two predecessors, in this respect: that it is no longer amenable to the original type of de-alcohol-conjugated polyatomic water-salts, but that it has suddenly become transferred to the typically distinct class of hydrocarbon-conjugated polyatomic water-salts (a species of typical metamorphosis which, in my system of notation, is indicated by the substitution of the symbol (!) for the symbol (-)).

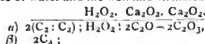
Finally, a mere glance at my formula suffices to show, that the carbonic acid must derive from the oxalic acid ally of the para-succinate, which has become oxidised at the expense of its freshly-acquired water base, while the liberated hydrogen unites with the hydrocarbon adjunct of the oxalic acid principal. The end product of this highly-interesting and instructive reaction is, therefore, the propionate of lime—



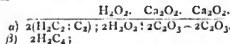
a variety of which I believe to be identical with the iso-propionate of our handbooks, while the β variety corresponds to the normal propionate.

(2). Let us, in the second place, consider the effects of heat upon the ordinary malate. These effects may be more advantageously studied and explained in connexion with the process of fermentation, which the malate is known to undergo whenever the combined energies of lime-water, a so-called ferment, and a suitable temperature are made to bear upon it. The chief products of the reaction consist in a mixture of the lime-salts of carbonic, iso-lactic (ordinary lactic), acetic, succinic, and butyric acids; and the principal molecular changes which characterise the different stages of this hitherto obscure and unfathomable process may be described as follows:—

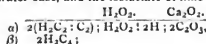
In the first stage, the malate of lime splits up into 2 molecules of water and the well known malate of lime—



the heterologue of the afore-mentioned succinate of lime, and the β variety of which I hold to be identical with the fumarate of our handbooks. At the same time the two liberated water molecules suffer decomposition, so as to yield up their oxygen to the oxalous acid principal, while their hydrogen unites with the biformen or deacetylen adjunct. The resulting product is, therefore, the isomaleate of lime—



The second stage is marked by the resolution of this lime-salt into carbonic acid, derived from the oxidation of the oxalic acid ally at the expense of its own freshly-acquired water-base, and the isolaetate of lime—

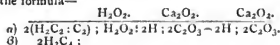


the α variety of which remains yet to be discovered, while the β variety corresponds to the ordinary lactate of our handbooks.

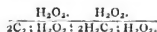
It is upon the new basis of the isolaetate of lime that I shall now proceed to expound the molecular changes, which accompany the production of the acetate and succinate of lime on the one hand, and the butyrate of lime on the other hand.

In the first place, as regards the acetate and succinate of lime. These two lime-salts, which require for their production the co-operation of 1 molecule of isolactate and 2 molecules of unaltered malate of lime, are formed simultaneously, in virtue of the following reaction:—First of all, the isolactate of lime resolves itself into a molecule of methylen-formylic or acetylic alcohol, both of which speedily merge into the isomeric acetate of water and into a molecule of formate of lime. The acetate then becomes oxidised into the acetate at the expense of 2 molecules of water, while the liberated hydrogen serves to reduce one of the accessory molecules of malate, with production of a molecule of succinate of lime. In like manner, the formate becomes oxidised into the formate of lime at the expense of 2 molecules of water, while the liberated hydrogen serves to reduce the other accessory molecule of malate, with production of a second molecule of succinate of lime. Finally, the newly-formed acetate of water, by transposing with the formate of lime, gives rise to acetate of lime and the unstable formate of water, which speedily resolves itself into 2 molecules of water and carbonic acid.

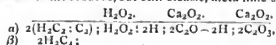
In the second place, as regards the butyrate of lime. This compound, which requires for its generation an excess of ferment, as well as a higher temperature, is derived from two molecules of isolactate, through the following series of molecular changes:—In the first stage, one of the isolactate of water molecules breaks up into a molecule of methylen-formylic or acetylic alcohol and a molecule of formate of lime. The formic acid constituent of this latter instantly unites as ally with the formic acid principal of the other molecule of unaltered isolactate. The resulting bibasic meta lime-salt is therefore expressed by the formula—



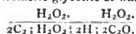
With the aid of 2 molecules of water, the liberated alcohol has at the same time become converted into the glycolic alcohol—



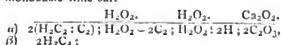
We now arrive at a remarkably interesting feature of the process, which is, that the ensuing molecular changes are due entirely to the reducing action of the glycolic alcohol on the afore-mentioned meta lime-salt. Accordingly, the first stage is marked by the separation of 2 molecules of hydrogen from the methylen adjunct of the glycolic alcohol, and their immediate conversion into 2 molecules of water at the expense of the formic acid principal of the meta lime-salt. The resulting products are, therefore, a molecule of the reduced, but still bibasic, meta lime-salt—



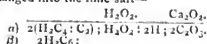
and a molecule of de-glycolic alcohol, which speedily merges into the isomeric glycolite of water—



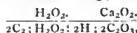
Subsequently, the reduced meta lime-salt, after transposing with the glycolite of water, becomes converted into the monobasic lime-salt—



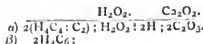
which, by the loss of 2 molecules of water, derived from the splitting up of the formylic alcohol ally, becomes still further changed into the lime-salt—



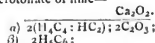
The next stage is marked by the conversion of the newly-formed glycolite of lime into the glycolate—



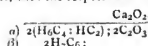
at the expense of 2 molecules of water, while the liberated hydrogen unites with the hydrocarbon adjunct of the aforementioned lime-salt, with production of the isobutylactate of lime—



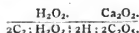
In the last stage, the ethylen-formylic or allylic alcohol of this latter compound splits up into 2 molecules of water and the corresponding hydrocarbon, which, by its immediate union with the formic acid principal, gives rise to a molecule of crotonate of lime—



at the same time, the two liberated water molecules suffer decomposition, so as to surrender their oxygen to the glycolate, while their hydrogen unites with the hydrocarbon adjunct of the crotonate. The resulting products are, therefore, a molecule of butyrate and a molecule of glycolate of lime, with the respective formulæ—

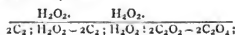


and—

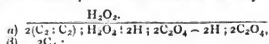


The preceding train of reasoning, regarding the soundness of which I must leave the reader to judge for himself, clearly proves that the evolution of hydrogen gas, which never fails to accompany the butyric fermentation, is due entirely to a secondary reaction, the cause of which is not far to seek. For we may well suppose that, under the combined influence of excess of ferment and a high temperature, the aforesaid glycolate of lime splits up into the formylic alcohol and the formate of lime, which, by transposing with the formite of water, into which the formylic alcohol has been made to pass, gives rise to formite of lime and the unstable formate of water. The latter splits up into 2 molecules of water and carbonic acid, while the formite becomes oxidised, first into the formate, and afterwards into the formate of lime, indubitably at the expense of the aqueous solvent, from which an equivalent quantity of hydrogen gas must therefore become evolved.

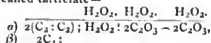
(3). Let us, in the last place, contemplate the effects of temperature upon the ordinary tartrate of water. When this substance is heated up to a certain point, it loses 2 molecules of water, and along with it the character of solubility; at the same time it ceases to exhibit the acid properties of an organic water-salt, while a few degrees below that point it retains still a distinctly acid reaction. Now, at first sight, and with no other facts to guide us, we might naturally take the insoluble product to be the ortho-tartaric anhydride—



but, after examining more closely into these relations, we are constrained to admit that this body is only an isomeric modification of the former, and so far as I know, still unsolitated compound. I have come to the conclusion that the insoluble product is the meta-tartaric anhydride—



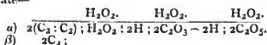
and I consider that the conversion of the soluble variety, or the so-called tartrate—



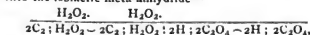
into this body is readily explained on the hypothesis that the two oxalic acid constituents become oxidised at the expense of their own water bases, while the liberated hydrogen re-unites as adjunct with the carbon nuclei of the freshly-formed bicarbonic acid constituents. It is self-evident, that the re-conversion of the meta-tartaric anhydride into the tartrate must be attended by a series of molecular changes, in which the order of molecular movements is absolutely reversed.

The reader cannot help admitting, that the two kinds of molecular rearrangement just described, in virtue of which an organic water-salt becomes suddenly deprived of one of its most characteristic chemical properties, and as suddenly re-endowed again, is a fact of the deepest theoretical value and significance. Having, in the course of my researches, become acquainted with a considerable number and variety of analogous cases, I have found it expedient to make use of the terms "ortho-genesis" and "meta-genesis," the former to denote the conversion of a meta-anhydride into the corresponding ortho water-salt, and the latter to denote the conversion of an ortho water-salt into the corresponding meta-anhydride.

The preceding remarks will, I trust, enable the reader to comprehend the precise nature of the molecular changes which accompany the action of heat on the ortho-tartrate up to the point where it changes into the meta-tartrate—

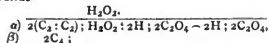


And here I may notice a peculiarity of the tartrate, whereby it differs remarkably from its two lower heterologues, and which consists in the circumstance, that its dehydration is invariably preceded by the formation of the meta-tartrate, while compounds corresponding to a metasuccinate and meta-malate, although theoretically possible, are as yet entirely unknown. This difference may be accounted for on the hypothesis that, in the existing conditions of the experiment, the tartrate is prone to merge into the isomeric meta-anhydride—



corresponding to the bibasic meta water-salt which, the reader will recollect, was encountered as a transition product in the oxidation of the tetratomic butylen erythrol.

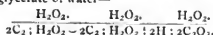
Let us, further, suppose that this compound resolves itself into 2 molecules of water and the meta-tartaric anhydride—



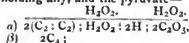
and that these two water molecules, instead of being eliminated, are instantly brought to re-unite as water bases with the acid constituents of the anhydride; we shall then, by this practical application of the above-mentioned method of meta-genesis, have put ourselves in possession of a powerful argument in support of the assertion, that the meta-tartrate of water is really constructed on the pattern of the formula assigned to it.

In all the cases hitherto examined, the bodies obtainable by the action of heat on the tartrate have this point in common, that they contain the same equivalent number of carbon molecules as the alcohol, from which they are descended. Let us now contemplate the case when, through the more energetic interposition of the same physical agent, the tartrate is forced to part with a certain portion of that element. In this process the carbon is always eliminated under the form of carbonic acid, while

the contents of the receiver are found to consist of the ordinary glycerate of water—

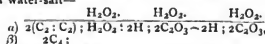


Evidently the carbonic acid is here, as it is in the majority of cases, derived from the oxalic acid ally, which becomes oxidised into this anhydride at the expense of its own water base; while the liberated hydrogen, by re-uniting as adjunct with the oxalic acid principal, transforms it into a formic acid principal. The resulting product is, therefore, a molecule of the glycerate, as formulated above. When the glycerate is strongly heated in its turn, it splits up into 2 molecules of water, derived from the formen-holding ally, and the pyruvate—

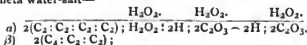


which, by this formula, is shown to occur in two isomeric modifications. Finally, when the pyruvate is strongly heated in its turn, 2 molecules of this compound are observed to conspire towards the production of 1 molecule of the ordinary pyrotartrate, while carbonic acid is given off.

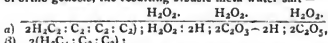
In this highly interesting and instructive metamorphosis, one of the two pyruvate of water molecules resolves itself, on the one hand, into a molecule of formate of water, the formic acid constituent of which instantly unites as ally with the formic acid principal of the other unaltered pyruvate of water molecule, with production of the bibasic meta water-salt—



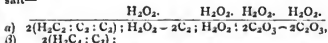
and, on the other hand, into the biformic or deacetylic alcohol, which (after previous conversion of the β into the α variety) speedily surrenders first the one and then the other of its constituent formen molecules to the biformen or deacetylen adjunct of the aforesaid meta water-salt, with production of a still more highly carbonated bibasic meta water-salt—



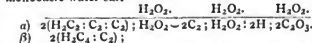
Subsequently, the formic acid ally of this compound becomes oxidised into a formic acid ally at the expense of the two liberated water molecules, while their hydrogen unites with the complex carbon adjunct. By the method of ortho-genesis, the resulting bibasic meta water-salt—



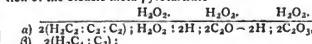
becomes then converted into the isomeric ortho water-salt—



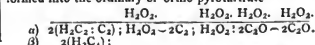
which speedily resolves itself into carbonic acid and the monobasic water-salt—



This latter, again, soon merges into the isomeric modification of the bibasic meta-pyrotartrate—



which, by the method of orthogenesis, is finally transformed into the ordinary ortho-pyrotartrate—

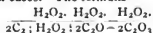


As it is my intention of resuming the subject of pyro-tartrate in a future communication, the reader is now requested to scrutinise the contents of the second chapter.

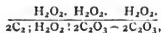
CHAPTER II.

On the Effects of Oxidising Agents upon the Ordinary Malate and Tartrate of Water.

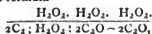
The chief products of this process are found to be the malonate and tartronate of water, while carbonic acid is given off in both cases. The formulæ—



and—

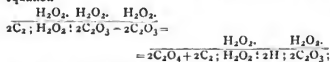


bear witness that, like their parent molecules, these two derivatives stand to each other in the relation of true heterologues, whilst the lowest member of this family-group, with the formula—

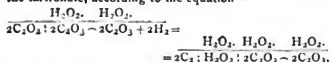


remains yet to be discovered.

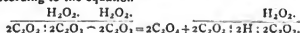
The reader will at once admit that this triad of acid heterologues must be descended from the olefine-begotten triatomic propylene-glycerol, that being the identical alcohol which, by oxidation, is known to furnish the ordinary glycerate. The following two cases appear to me well adapted to elucidate the precise nature of those family ties, that connect the glycerate with the two compounds under consideration; but, before entering more deeply into this subject, I have deemed it advisable to interweave a few remarks explanatory of the genetic relations which subsist between the tartronate and divers other organic combinations, as, for example, the mesoxalate, glycolate, and glyoxalate. Thus, it is proved by experiment—(1) That, under the influence of heat, the tartronate splits up into carbonic acid and the glycolate, according to the equation—



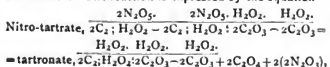
(2) that nascent hydrogen converts the mesoxalate into the tartronate, according to the equation—



where, in striking contrast with received notions, the reducing energies of the hydrogen are expended upon the carbonic oxide adjunct in preference to the more highly-oxidised oxalic acid principal; (3) that heat causes the mesoxalate to split up into carbonic acid and the glyoxalate, according to the equation—

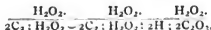


Reverting again to the two cases proposed for analysis, I shall, in the first place, seek to interpret the molecular changes, which culminate in the production of the tartronate. A solution of the nitro-tartrate of water suffers decomposition even in the cold, the chief products being the tartronate, while carbonic acid and nitric oxide are evolved. The reaction is expressed by the equation—

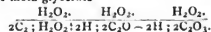


and the accompanying molecular changes are thought to be as follows:—With the aid of 2 molecules of water, the

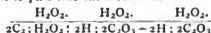
nitro-tartrate resolves itself, in the first stage, into 2 molecules of nitrate and 1 molecule of tartrate. The latter soon splits up into carbonic acid and the monobasic glycerate—



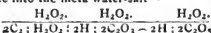
which speedily merges into the isomeric modification of the bibasic meta-glycerate—



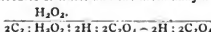
By the oxidising action, first of one, and then of the other molecule of nitrate, the meta-glycerate is in the second stage made to pass into the meta water-salt—



and thence into the meta water-salt—

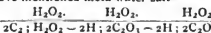


The third stage is marked by the resolution of this latter into 2 molecules of water and the meta-anhydride—



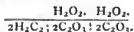
which, by the method of orthogenesis, becomes finally converted into the isomeric tartronate, as formulated above.

I shall, in the second place, seek to interpret the molecular changes which culminate in the production of the malonate. When ordinary malate of water is treated with bichromate of potash and sulphate of water in the cold, the chief product is found to be the malonate, while carbonic acid is evolved. In this process, the malate is first of all oxidised into the tartrate, which soon splits up into carbonic acid and the glycerate. From this point the molecular changes are precisely as in the former case, except that, owing to the more scanty and sluggish supply of oxygen, the process terminates with the formation of the above-mentioned meta water-salt—

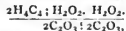


which becomes finally reduced to the state of malonate by the same kind of metamorphosis I have just shown to accompany the production of the tartronate.

Great theoretical importance attaches to the fact that, at a certain temperature, the malonate splits up into carbonic acid and the ordinary acetate; and the reader, by taking his cue from my analysis of kindred phenomena, will not be slow to perceive that the intermediate product must be the para-malonate—



The kind of metamorphosis here referred to, so far from being of an exceptional character, is, by the annexed scheme, shown to be a feature common to a whole series of homologues. The first member of the para-series, viz., the para-oxalate, is still unknown, but I consider it highly probable, that the so-called oxalovinate—



is one of its ethylic ether derivatives. Under the influence of heat, this series of bibasic homologues is observed to give birth to a second series of monobasic homologues, which coincides in every respect with the series of the so-called fatty acids.

Having now presented the reader with a plain, intelligible, and, I trust, also correct analysis of the molecular changes, that accompany the natural production of the water-salts of succinic, malic, and tartaric acids in the living organism, I shall in the sequel endeavour to accomplish the analysis of the molecular changes, that accompany the artificial production of these compounds in our laboratories. The reader is, therefore, invited to ponder

TABLE OF GENETICALLY-RELATED WATER-SALTS OF THE FATTY ACIDS.

First Series of Acid Homologues.

Bibasic Water-Salts of the Fatty Acids.

	H_2O_2 , H_2O_2 .
Para-oxalate ..	$\frac{2\text{C}_2\text{O}_3}{2\text{C}_2\text{O}_3} : \frac{2\text{C}_2\text{O}_3}{2\text{C}_2\text{O}_3} = 2\text{C}_2\text{O}_4 +$
	H_2O_2 , H_2O_2 .
Para-malonate ..	$\frac{2\text{H}_2\text{C}_4}{2\text{H}_2\text{C}_4} : \frac{2\text{C}_2\text{O}_3}{2\text{C}_2\text{O}_3} : \frac{2\text{C}_2\text{O}_3}{2\text{C}_2\text{O}_3} = 2\text{C}_2\text{O}_4 +$
	H_2O_2 , H_2O_2 .
Para-succinate ..	a) $\frac{2(\text{H}_4\text{C}_2 : \text{C}_2)}{2(\text{H}_4\text{C}_2 : \text{C}_2)} : \frac{2\text{C}_2\text{O}_3}{2\text{C}_2\text{O}_3} : \frac{2\text{C}_2\text{O}_3}{2\text{C}_2\text{O}_3} = 2\text{C}_2\text{O}_4 +$
	$\beta) \frac{2\text{H}_4\text{C}_2}{2\text{H}_4\text{C}_2} ;$
	H_2O_2 , H_2O_2 .
Para-pyrotartrate ..	a) $\frac{2(\text{H}_6\text{C}_4 : \text{C}_2)}{2(\text{H}_6\text{C}_4 : \text{C}_2)} : \frac{2\text{C}_2\text{O}_3}{2\text{C}_2\text{O}_3} : \frac{2\text{C}_2\text{O}_3}{2\text{C}_2\text{O}_3} = 2\text{C}_2\text{O}_4 +$
	$\beta) \frac{2\text{H}_6\text{C}_4}{2\text{H}_6\text{C}_4} ;$

Second Series of Acid Homologues.

Monobasic Water-Salts of the Fatty Acids.

	H_2O_2 .
Formate ..	$\frac{2\text{H}}{2\text{H}} : \frac{2\text{C}_2\text{O}_3}{2\text{C}_2\text{O}_3}$.
	H_2O_2 .
Acetate ..	$\frac{2\text{H}_3\text{C}_2}{2\text{H}_3\text{C}_2} : \frac{2\text{C}_2\text{O}_3}{2\text{C}_2\text{O}_3}$.
	H_2O_2 .
Propionate ..	a) $\frac{2(\text{H}_4\text{C}_2 : \text{HC}_2)}{2(\text{H}_4\text{C}_2 : \text{HC}_2)} : \frac{2\text{C}_2\text{O}_3}{2\text{C}_2\text{O}_3}$.
	$\beta) \frac{2\text{H}_3\text{C}_2}{2\text{H}_3\text{C}_2} ;$
	H_2O_2 .
Butyrate ..	a) $\frac{2(\text{H}_6\text{C}_4 : \text{HC}_2)}{2(\text{H}_6\text{C}_4 : \text{HC}_2)} : \frac{2\text{C}_2\text{O}_3}{2\text{C}_2\text{O}_3}$.
	$\beta) \frac{2\text{H}_7\text{C}_6}{2\text{H}_7\text{C}_6} ;$

the third part of my programme, where a fresh crop of valuable experimental evidence will be laid before him in support of the new views and doctrines I have ventured to promulgate.

(To be continued.)

ON THE ASH OF DISEASED POTATOES.

By ALEXANDER S. WILSON.

THE CHEMICAL NEWS, vol. xxviii., p. 147, contains an interesting paper, by Mr. J. B. Hannay, on the "Inorganic Constituents of Sound and Diseased Potatoes." From the analyses there given, Mr. Hannay concludes that the amounts of potassium, chlorine, and sulphuric acid are greater in diseased tubers than in sound ones, whilst the amount of soluble phosphoric acid is less.

The analyses admit of some other generalisations, but the author has either overlooked them, or they have been omitted in your report. On looking over a table of analyses of the ashes of potatoes, as given in some works on agriculture, one is struck with the great discrepancies between the different analyses; and when we attempt to compare the analyses of diseased samples with these, the task is one of difficulty, for we are at a loss with which to compare them; hence, doubtless, arose those differences of opinion as to the increase or decrease of potash in diseased roots, which Mr. Hannay notices, and which he has avoided by making analyses of good and bad samples taken from the same field.

Some time ago I made an analysis of the ash of a sample of diseased potatoes, which I dug, in the end of last season, from a plot of ground which was, I should say, favourably situated for the development of the disease, and consequently unfavourable for that of the potato. The soil in which these potatoes were grown consisted, for the most part, of disintegrated sandstone and decayed vegetable matters; the season, it will be remembered, was an excessively wet one. Unfortunately I was unable to obtain a sample of sound tubers from the same lot, and the leaves and stems were so far decayed that I did not consider them suitable for analysis. The potatoes were the kind known as "regents," and the tubers themselves were very much diseased, so much so that I question if they could have been used for feeding cattle.

One source of discrepancy in analyses of this kind must be noticed. This is the earth, which adheres tenaciously to the tubers, particularly in the eyes, even of sound potatoes, and penetrates into the substance of the diseased tubers in such a way that its separation can only be effected by cutting away the part. In this way a large portion of the cuticle is removed; now, the cuticle differs considerably in composition from the rest of the root, and from this cause considerable errors may creep into results, even although all the earth may have been removed from the sample. In preparing this sample I carefully removed the earth from the exterior, and cut out those parts where the sand was so much mixed up with the diseased substance as to render this impossible. A large quantity of

the sample thus treated gave 1.07 per cent of mineral matter, which had the following composition:—

Potassium ..	44.51
Sodium ..	0.25
Magnesium ..	2.36
Calcium ..	1.12
Phosphoric anhydride ..	14.48
Sulphuric anhydride ..	5.37
Carbonic anhydride ..	15.80
Chlorine ..	1.37
Ferric oxide ..	0.53
Silica ..	2.89
Oxygen, equivalent to K, Na,	
Mg, and Ca, minus equivalent	11.22
proportion of Cl ..	..

100.10

On comparing these results with Mr. Hannay's, and with a number of analyses of sound tubers, I find that, so far as increase of potash and sulphuric acid are concerned, they confirm his conclusions; and, if they do not show that the phosphoric acid does not decrease, they at least show that some diseased tubers contain as much as some sound ones do; the chlorine, too, in this sample is less than in Mr. Hannay's sound sample. But what I wish particularly to direct attention to, is the small amount of lime and magnesia which the sample contains; in none of the analyses which I have consulted are the percentages so low as in this sample. Different observers state the percentage of magnesia in the ash of sound tubers at from 5 to 10 per cent; in this case it is only 3.94 per cent. In the two samples of diseased ash, Mr. Hannay only found 1.00 and 0.1 per cent of magnesia. Similarly, Mr. Hannay's, as well as my own, results show that the amount of lime is abnormally low in the diseased samples. In this case I found 1.77 per cent of lime; in the sound sample Mr. Hannay found 5.19 per cent, and considerably less in both the diseased samples. With regard to the sound sample, however, it may be observed that even, although these tubers were sound—that is, although they had not been attacked by the fungus,—still the vitality of these plants must have been considerably reduced by the unpropitious weather of last year, so as to render them liable to succumb on the deposition of the spores of the fungus on their stomata. This want of vitality may fairly be conceived as due to the presence of noxious, or the absence of necessary, substances in the juices of the plant, and such conditions must undoubtedly be the counterpart of the unfavourable circumstances under which the potato has laboured in many parts of the country, and in some years to a greater extent than in others. The potato plant is in every part of its structure strikingly adapted for a dry climate and light soil. When we consider that it has for many years been cultivated under the very reverse of these conditions, and that its structure has not varied to accommodate it to the changed circumstances, we cannot wonder that it has fallen the prey of its enemies.

With these considerations before us, I think that we

are justified in appealing to chemical science—to solve the problem as to the prevention of the disease—to suggest not a substance that will destroy the enemy, for this is next to impossible, but to give the plant such nourishment that will enable it to resist the adverse circumstances in which it is placed, as well as the attacks of its own peculiar enemies.

Some years ago, Professor Thorpe found, from the analyses of diseased and healthy orange trees, that, in the former, the amounts of lime and magnesia are deficient; the same thing, we have seen, is the case in the diseased potato plant.

It has lately been shown, by Dr. F. Crace Calvert, that lime is one of the few substances which we know that are capable of altogether preventing the development of fungi in organic solutions. He does not give any experiments relating to the action of caustic magnesia on fungi, but doubtless its action will be found to be similar.

Here, then, is a curious and, at the same time, significant fact—Diseased potatoes are deficient in lime salts: lime prevents the development of fungi. May not the development of fungi in the vessels of plants be furthered by this deficiency? The circumstances are such as scarcely to leave room for doubt. So far, then, theory and practice agree; lime has been found by experience to be useful in preventing the disease, and I cannot doubt that magnesia, if tried, will be found to have a similar effect.

ON THE ENERGIES OF THE IMPONDERABLES, WITH ESPECIAL REFERENCE TO THE MEASUREMENT AND UTILISATION OF THEM.*

By the Rev. ARTHUR RIGG, M.A.

(Continued from page 80.)

LECTURE III.

On the Energy of Vitality, with especial reference to the Measurement and Utilisation of it.

THE "Energy of Vitality" is a manifestation by motion of the unknown and unseen power which is associated with life—indeed that which may (perhaps) be said to constitute life itself. This vital power (some may call it force) is presented to our notice in two forms, the animal and the vegetable; hence the two sciences of zoology and botany.

In the distinctions laid down in the classification diagram, it will be observed that the energies are divided into potential and kinetic.

In seeds, in eggs, in frozen toads, in suspended animation, in hibernating animals, are examples of the potential energy of vitality. The power is there, but it awaits those surroundings which may convert this potential or dormant energy into kinetic or active energy. So long as a living body lives, it possesses kinetic energy; it has power to move. Such a power is not possessed by any dead body, although from external sources it may be introduced into one.

The energy of vitality is converted into the energy of affinity in the assimilation of food, into that of electricity in muscles and muscular action, into that of light as in glow-worms and certain fishes, and into that of heat as in warmth of the body. One peculiarity of this vital power is the ability to seize on that which is material, and to adapt or select therefrom whatever may be suited for its special purpose. The earliest or most elementary of the animal forms in which this vital power of adaptation displays itself is called a protoplasmic germ. This germ, or, as it may be described, this microscopical cell, if placed in congenial surroundings, manifests an energy of growth or reproduction which adapts these surroundings in a way and under an influencing power quite unknown to us. The power of gravity enclaspeth all matter, the power of vitality exercises a selectiveness from matter—gravity

influences all matter, but changes the shape of none; vitality changes the form of all its influences. For example: the process of fermentation is one in which a minute molecule possessed of a vital power can communicate a similar power to another molecule, this again to another, in each case appropriating or attaching the molecule to itself for awhile, and so producing a rapidity of what we call growth, which seems almost as a process of crystallisation when the water of solution is being evaporated.

Between the development of a crystal, however, and of life, there is this marked difference. A crystal grows by appropriating like molecules, and deals with them according to laws unknown to us; a body having vitality not only appropriates various molecules, but re-combines, re-forms, and rejects. These the crystal cannot do. The growth of a crystal is a phenomenon in physics, the growth of an animal is a phenomenon in chemistry. In both cases, the powers of reproduction or enlargement are mysterious. Although under the influence of vitality many forms of matter are produced, yet the crystalline one never appears; as soon, however, as the excretory processes are completed, or the vital power is withdrawn, then commences work of a crystalline character.

How vitality is transferred, or what it is, or in what contained, how nourished, or how destroyed, we know not. With the energy of vitality, as manifested in the processes of reproduction and growth, we are not this evening required to deal. Within that frame thus mysteriously developed, there are combinations of mechanical and chemical apparatus fulfilling conditions with which we are deeply concerned. This apparatus, however, does not from year to year retain the same power. Owing to the vital action, the apparatus with which we are to deal, whilst in incessant fluctuating change, yet attains a climax, then slowly subsides, then follows that phenomenon, even more mysterious, if possible, than any other of the vital ones, viz., their sudden cessation, which we call death. Neither in its earliest development nor in its mysterious cessation are those phenomena presented which are consequent upon energies we can either measure or utilise. Whence that comes which imparts vital energy, and whither it goes, are problems rather for human faith than human understanding. When an engineer has to estimate the power of a steam-engine, he does not ask of its early formation and past biography, nor does he speculate upon its future uselessness; he regards it as he finds it. So with animal vitality. We have to regard the animal as an engine, and in lieu of steam we have vitality. The engine is constructed so as to be utilised by the power of vitality, as that other engine is by the power of heat. Animals are much more economical engines than any man has made. The Creator's work is still far in advance of the work of the creature. Count Rumford showed that the amount of work done by a horse is much greater than could be obtained by employing its food as fuel for a steam-engine.

Note, also, what an economical conserving of energy there is in hibernating animals, which store up in summer that which they expend in winter in maintaining animal heat. To those who intend to offer the results of their ingenuity in the economising of fuel for the gold medals and £50 prizes offered by this Society, in December next, may be commended for especial study this property of hibernating animals. Your lecturer has no authority to make the statement, but he can with some confidence assure them that, if successful in teaching us to economise fuel as they do, they will win not only the prizes of the Society, but also the thanks of the nation.

An animal body is, indeed, a wonderful self-acting and self-regulating machine. It is a structure composed of movable parts, yet firm, and at the same time locomotive. Its hinges are well fitted with self-acting lubricators; its furnace supplies itself with fuel,

* The Cantor Lectures, delivered before the Society of Arts.

and can regulate the supply to the demand; its telegraphic communications are extensive, rapid, and need no superintendence; in its laboratory are performed experiments in the very highest departments of organic chemistry.

There are two forms of vital energy which have so much of a kinetic character that we may utilise them. Indeed, one form is self-utilised; vitality seems to have engaged its exclusive services, and whether the animal be waking or sleeping, vitality claims all those services from the machinery of the body which are rendered in the circulation of the blood, the digestion of the food, the operation of breathing, the propelling action of the heart. These are all motions resulting from some impressed laws, which have hitherto been hidden from our powers of research. That they continue, and that we are unconscious of them; that we cannot stop them, and even if we could by any means measure them, that we could not transfer them to any other purpose is clear without demonstration.

Therefore, since for scientific physiology the study of this form of vital energy is of paramount importance, it very naturally and properly would rank as one of the chief subjects for medical students. Indeed, the minds of physicians are necessarily often guided by circumstances to meditate upon its operation, and they are called upon to accelerate its action here and to retard it elsewhere. Hence the observant anatomist becomes, if not a kinetic, at least a static mechanician; the thoughtful physician reflects and harmonises the external evidences of these internal energies, and combining the events which fall under his notice, he deduces conclusions which link the laws of vital energies in their operations with those of the other imponderable influences which pervade all the universe.

Under such circumstances as these, Dr. Mayer, of Heilbron, in Germany, was led to conclusions in respect to the relations between heat and work which the further investigations of others by very different processes—processes in which the energy of vitality does not enter—have established as correct.

There is another form of vital energy similar to this over which we have control, and which we employ as we please within the limits which the vital power and the construction of the apparatus through which it acts permit. This is that to which we usually give the name of "muscular energy."

The qualifying words "within the limits" are essential, for the limit is in each case a hard and fast line, and we cannot overstep it. This limit is, perhaps, more admirably arranged in the animal frame than in any construction of man's devising. Although there are hundreds of muscles, yet their names, shapes, and businesses are very varied. Throughout all these changes one remarkable principle applies: every muscle is exactly adapted to the work it is likely to be called upon to perform.

There is a principle in mathematical science called the "Principle of least action." It may be explained thus—Given an object to be accomplished, then "the principle of least action" should teach how, with the smallest quantity of material and with the least expenditure of power, that object would be done. The more the muscular system is examined under this guidance, the more we are lost in wonder how exactly every portion of the body is suited for its specific work, and for the amount of work it is likely to be called upon to discharge, and more curious still, how (in special cases) the muscle may develop in order to meet certain requirements, as, for example, the muscles in the arms of a smith, as well as other muscles. And, further, how perfectly these muscles are varied in form and construction so as to meet the requirements of their respective occupations, and, if called upon by prospective emergencies, to be ready for more than ordinary exertion. Certain muscles are so prepared for extraordinary exertion, and then relax into their normal state, thus strictly carrying out the "principle of least action."

(To be continued.)

NOTES ON THE

DETERMINATION OF TITANIC ACID IN TITANIFEROUS IRON ORES, ETC.

By WILLIAM BETTEL.

I TRUST the following modification of Mr. David Forbes's process ("Select Methods in Chemical Analysis," pp. 110 to 111) for the estimation of titanic acid, may not be unacceptable to those engaged in the analysis of titanic ores:—

Pulse about 0.5 gm. of the finely powdered ore with 6 grms. of pure bisulphate of potash (which has been recently fused and powdered) in a platinum crucible at a gentle heat, carefully increased to redness, and continued till the mass is in tranquil fusion.

Remove from the source of heat, allow to cool, digest for some hours in 5 or 6 ozs. of cold distilled water—not more than 10 ozs. is to be used, as it generally causes a precipitation of some TiO_2 —filter off from a little pure white silica, dilute to 45 or 50 ozs., add sulphurous acid until all the iron is reduced, then boil for six hours, replacing the water as it evaporates.

The titanic acid is precipitated as a white powder, which is now to be filtered off, washed by decantation, a little sulphuric acid being added to the wash-water to prevent it carrying away TiO_2 in suspension. Dry, ignite, allow to cool, moisten with solution of ammoniac carbonate, re-ignite, and weigh. The titanic acid is invariably obtained as a white powder with a faint yellow tinge, if the process has been properly carried out.

I find the method of fusing with bisulphate of potash ("Select Methods," p. 115) to be preferable to all others for decomposing difficultly soluble iron ores.

Borough Laboratory,
84, Milton Street, Middlesbrough,
August 12, 1873.

CORRESPONDENCE.

AMMONIA TEST FOR DRINKING-WATER.

To the Editor of the Chemical News.

SIR,—The importance of the ammonia test for drinking-water, and the extensive use now made of it, render it desirable that it should be as accurate and as easy of application as possible. In common with others, we have had great trouble in using it, in consequence of the slowness and uncertainty of the Nessler reaction.

In a recent letter, Mr. Wanklyn attributes this to the manner of preparing the Nessler solution, chiefly to the neglect of the addition of mercurial solution at the end of the process. Although this may be the cause in some cases, it is certainly not so in all, and I desire to point out a source of difficulty which appears to have been hitherto overlooked; this is the presence of carbonic acid in the liquid to be tested. In a distillate, unless it has been exposed to the air for some time, this is not likely to occur, and accordingly I have frequently found a sharp reaction in the distillate, but no reaction in the comparison liquid until after a preposterously large quantity of the ammonium chloride solution had been added, or until a very long time had elapsed. Recently, examining the distilled water which gave this result, I found in each instance that there was a considerable quantity of carbonic acid present, and that, by taking fresh distilled water free from carbonic acid, a sharp and immediate reaction was obtainable. Similarly, if there be carbonic acid in the distilled water with which the ammonium chloride solution is made, there will be delay in the reaction.

The explanation is, that the carbonate, as well as other salts of ammonia, will give a reaction with Nessler's solution in extremely small quantity, but the addition of

an excess of carbonate or carbonic acid alone will re-dissolve the precipitate, or discharge the colour of the liquid.—I am, &c.,

F. DE CHAUMONT, M.D., Surgeon-Major.

Laboratory, Army Medical School,
Royal Victoria Hospital, Netley,
August 19, 1873.

NOTICES OF BOOKS.

Half-Yearly Compendium of Medical Science. Part IX., January, 1872. Philadelphia: S. W. Butler.

THIS compendium takes a wider scope than its English contemporary, Brailhwaite's "Retrospect," and contains a large and varied amount of important matter, selected from European as well as from American authorities. If we do not quote any of its chemical notes, it is merely on account of their dating nearly two years ago, and having consequently been brought before the public through other channels. We are particularly struck with an article on the "Pathological Effects of the East Wind," which, though not coming within our ordinary scope, is profoundly suggestive, and may, perhaps, offer the key to many unsolved questions, psychological and social as well as pathological.

We notice a feature in the paging of the book which may be worth imitation in works of a similar nature. The running page of each number is at the bottom, whilst each department is paged independently at the top. Thus the work when bound resolves itself into a number of separate volumes on "Materia Medica and Therapeutics," "Clinical Medicine," &c. In the table of contents, the names of American authors are given in small capitals, those of foreign authors in Italics.

Proceedings of the American Pharmaceutical Association at the Twentieth Annual Meeting, held in Cleveland, Ohio, September, 1872. Philadelphia: Sherman and Co.

THESE "Proceedings" contain both scientific matter and important papers bearing on the drug trade, and on the status and prospects of the pharmaceutical profession in the United States. The organisation of the Association appears to us complete and efficient. There are standing committees on the drug market, on the progress of pharmacy, on adulteration and sophistication, on legislation, on infringement of stamp tax, and on a variety of other matters of importance to the profession.

Many of the papers read, though not of a character coming within the ordinary scope of our cognisance, strike us as being exceedingly valuable. Prof. Moore's strictures on certain "commercial elixirs," as being merely a fashionable way of getting stimulants into the stomachs of women and children, are quite applicable on this side of the Atlantic.

There is a lengthy paper on the manufacture of glass as applied to the make of bottles for containing chemicals. None of the forms of stopper suggested equal, in our opinion, the mushroom pattern, in which the stopper, properly so-called, terminates in a cap, concave downwards, so as entirely to protect the lip from dust. The absurdity of putting articles easily acted on by light is denounced, and a canary-yellow shade, producible by uranium, is shown to be much superior for such preparations, as cutting off the so-called chemicals rays of light.

There is some discussion on insects capable of acting as substitutes for cantharides. Here we must protest against the unscientific custom of applying the term "bug" to coleopterous insects or beetles, an error as great as the Cockneyism of calling the cockroach a black-beetle.

There are well-grounded complaints on the increasing prices of drugs and chemicals, aggravated in America by

a scale of import duties almost as vexatious as those under which our grandfathers laboured in the good old days of the younger Pitt. It is doubtless a mark of great liberality on the part of Congress that indium is admitted duty free.

We are glad to find that the efforts of American pharmacists for securing a higher educational standard in their body, and for excluding incompetent persons from the profession, are seconded by public opinion and by the legislature.

A paper on the analysis of glacial phosphoric acid of commerce shows that many samples contain as much as 10.7 per cent of soda. Arsenic in minute traces was found only in one sample.

An appendix treats of the weather observations and the storm-signal service in the United States.

We cannot conclude this brief notice without expressing our cordial sympathy with the American pharmacists in their efforts for the organisation of their profession and for the elevation of its status.

A Compendious Manual of Qualitative Chemical Analysis. By C. W. ELIOT and F. H. STORER. Revised by WM. R. NICHOLS, Professor of General Chemistry in the Massachusetts Institute of Technology. Second revised edition. New York: D. Van Nostrand.

MANUALS of chemical analysis, especially qualitative, have a strong family likeness, and their increasing number renders it difficult to say which we should prefer. In the work before us there is little to which we can object. The usual tests and the precautions to be observed in their application are carefully and clearly described.

It strikes us, however, as rather strange that of the known metallic elements twenty-two only are taken into consideration. Those omitted cannot be, as a class, pronounced either rare or unimportant. Some of them are of frequent occurrence both in natural minerals and in manufacturing products and residues. They are capable of modifying or simulating characteristic reactions, and of interfering with industrial processes. Some of them—we may instance uranium and tungsten—have their practical applications. On these grounds we are led to doubt whether their sweeping exclusion from elementary analytical manuals is altogether judicious. We would not certainly plunge the beginner into the niceties requisite for recognising the various members of the cerium group, but we submit that Messrs. Eliot, Storer, and Nichols have fallen into the opposite extreme.

Turning to the instructions given for the detection of phosphoric acid, we find it stated that the molybdate of ammonia test "can be used in presence of arsenic acid." Neither is there any caution given as regards the presence of silicic acid in the substance under examination. Yet the highest authorities have shown that both arsenic and silicic acids form, with molybdic acid, precipitates similar to that yielded by phosphoric acid under the same circumstances, and have therefore insisted on the elimination of the two former bodies as a necessary preliminary to the use of the molybdic test. It is perfectly true that the addition of a few drops of a solution of arsenic acid or of a soluble arseniate to the molybdic test-liquor does not cause, in the cold, the immediate formation of a yellow precipitate. But neither is it safe to infer the absence of phosphoric acid if a precipitate is not at once formed in a cold solution. Either prolonged standing or digestion at a gentle heat is necessary if the amount of phosphoric acid is minute. We are, therefore, compelled to pronounce this paragraph as unsatisfactory, and to suggest to the editor the propriety of its revision.

The formula given for the "magnesia" mixture used in the detection and estimation of phosphoric acid appears preferable to that of Fresenius, as being less likely to cause the precipitation of magnesian hydrate.

The appendix contains directions for the preparation of the necessary reagents, a list of apparatus, and some brief

but valuable notes on manipulation. We quote the following passage:—"Whenever a reagent is to be used, the bottle which contains it should be grasped in the right hand; the stopper should be taken out by pinching it between the first (thumb) and second or third and fourth finger of the left hand, or by pressing it between the little finger and the palm of that hand. In either case the bottle is withdrawn from the stopper, not the stopper from the bottle. Neither bottle nor stopper should be put upon the table; the stopper should be held in the left hand as long as the bottle is open. When the reagent has been poured out the bottle is immediately closed and returned to its place upon the shelves. If these apparently trifling particulars are scrupulously attended to, no stopper can ever be misplaced or soiled by contact with liquids or dirt on the table. Moreover, the label on the bottle cannot be injured by drops of the reagent, since the liquid must necessarily be poured from the back or blank side of the bottle." If students trained in such principles do not become sound, accurate chemists, the fault will be their own.

MISCELLANEOUS.

Public Analyst for Salford.—At a meeting of the Salford Town Council, held at the Town Hall, Salford, on the 6th inst., Mr. Alderman Davies moved: "That the Council be recommended to appoint Mr. Joseph Carter Bell, F.C.S., to be public analyst for the borough, and that his remuneration be by fees or allowances, as provided by the Adulteration of Food, Drugs, &c., Act, 1872, such appointment to be terminable by three months' notice in writing from either party." He said that, according to the Act of Parliament, the minimum fee of the public analyst would be 2s. 6d., while the maximum fee would be 10s. On the appointment of Dr. Tatham as medical officer of the borough, it was thought that he would undertake the duties of public analyst, but Dr. Tatham had found that his time was fully occupied with his own duties, and had expressed himself unwilling to undertake the office of public analyst. Mr. Alderman McKerron, in seconding the motion, said he considered the Council had been fortunate in obtaining the services of Mr. Bell, as there were few gentlemen of his qualifications who would accept the appointment without a fixed salary. The motion was passed.

Impure Water.—At a recent meeting of the Chemico-Agricultural Society of Ulster, Dr. Hodges reported the results of several analyses of the water of springs. He said that the composition of the water supplied in the districts surrounding Belfast continued to receive attention from him, and in consequence of his representations much improvement had been effected, and the use of some waters which he had found largely contaminated with sewage impurities had been abandoned. This inquiry at the present time was of especial importance. In several cases the outbreak of fever was the first thing which attracted attention to the impurity of the water used. He had formerly reported that the water supplied to the District Lunatic Asylum at Downpatrick had become polluted by sewage matters, derived from sewers which passed near the well. This cause of danger to the inmates of the establishment had now been removed; and lately he had the satisfaction of reporting that the water now supplied was of very superior quality. A water, Dr. Hodges stated, may be turbid, and deposit a sediment on standing, and be free from sewage impurities. Thus, occasionally the town water was turbid, like all waters from districts abounding in peat; but this impurity did not appear to exercise any effect injurious to health. It should, however, be removed by a more perfect system of filtration than that at present in use. Nitrogenous impurities are, however, very different from those derived from peat and soils rich in vegetable matters, and the presence in a

water of a large amount of ammonia or of albumenoid ammonia is always to be regarded as significant of danger. It is true that the large extent of land drained by streams must, in many cases, convey to the rivers from which the water supply is frequently derived, refuse matters containing nitrogenous matter in various forms, even when no sewage matter is present. But this pollution may become a cause of disease, and when wells or streams are situated in the midst of a dense population, the nitrogenous matters carried into them are especially dangerous, and their amount is usually regarded as a measure of the quality of the water and its suitability for domestic use. As an illustration of the power which we possess of preventing disease, the valuable report of Surgeon-Major De Renzy, "On the Extinction of Fever in the Millbank Prison by the Disuse of Thames Water," is most instructive, and deserves the careful consideration of the public bodies in this and other towns. It appears that the convicts in the prison previous to 1822 had been subject to an intestinal flux, which the medical officer supposed to be due to over-feeding and insufficient exercise. The dietary was altered; yet three months after an epidemic of dysentery, diarrhoea, and fever, accompanied with scurvy, began, affecting 500 convicts out of the 880 confined. In 1832 the prison suffered severely from cholera, and then some subsequent severe visitations of dysentery, fever, and cholera. The opinions of the leading scientific men of the metropolis were obtained, and means for securing ventilation, &c., were tried, but without effect. In the years from 1845 to 1854 there were 57 deaths from typhoid. The water supply was changed in August, 1854. Up to that date the water used was taken from the Thames, as it flows by the prison, purified by filtration. The new supply was from an artesian well in Trafalgar Square. It was during the severe epidemic of cholera, and there were cases of cholera in the prison at the time. Six days after the change the disease suddenly ceased, and a marked improvement took place in the health of the prison. From that period up to April, 1872, a period of nearly nineteen years, there have been only three deaths from typhoid, viz., one in 1855, one in 1860, and one in 1865. Of these, the last occurred in a convict who was suffering from the disease at the time of his admission. In the first part of 1854, and before the change of water supply, there had been three deaths from fever and two from diarrhoea. In the nineteen years since the change of supply there has been only one death from these diseases, and this change occurred while in all other respects the sanitary condition of the prison remained unaltered. As an instance of the extent to which the wells in the country may become defiled by sewage matter, Dr. Hodges gave the following analysis of water from a well at Larchfield, near Hillsborough, which had been examined for a member of the Society:—

An imperial gallon contained—	
Total solid matters	35°0 grs.
Consisting of—	
Mineral and saline matters	22°4 "
Organic and volatile matters	12°6 "
Chlorine, equal to 6½ grs. of common salt per gallon.	
One million parts contained—	
Free ammonia	0°02 part.
Albumenoid ammonia	0°30 "

Water Supplied from Calcutta Hydrants.—In his report on the water supplied from the Calcutta hydrants during the year 1872, Dr. F. N. Macnamara says:—"Transparency has been determined by the examination of a column of water in a 2-foot tube. It was found defective on seventy days, as against eighty-six days of last year when such imperfection was noticed. Defective transparency is in the case of this water always due to the presence of very minutely divided clayey matter. This is the same stuff which is so largely present in the river-water during the rains, and is in a so finely divided state,

and is so light, that the water must be allowed to stand for at least four or five days before it clears by subsidence—filtration through several folds of filtering-paper does not remove the cloudiness. On some occasions the cloudiness became apparent in a very sudden and marked way, and was then accompanied by an increase in the organic matter dissolved in the water, but on other occasions a faint cloudiness of the water was not associated with increase of organic matter. This is a point which was particularly attended to, as there has been dispute regarding it amongst observers in England, amongst whom some have held that access of cloudiness to the water must necessarily be accompanied by an increase of organic matter. I have, however, satisfied myself that this view is an erroneous one, and that loss of transparency is not necessarily accompanied by any determinable addition to the organic matter in the filtered water. *Chlorine, Determined in the Water without Evaporation in the usual way with Solution of Nitrate of Silver, and Chromate of Potash as Indicator.*—On no day during the year has there been such increase in the quantity of the chlorine in the water as to lead to suspicion of tidal water being pumped into the reservoirs at Pultah. The largest quantity of chlorine found in the water was in the first week in May, when it reached 9.2 parts per million (equal to 1.06 grs. of chloride of sodium per gallon). The smallest quantity found was in November, when it fell to 3.9 parts per million. *Organic Matter.*—The organic matter was present in small quantity in the filtered water till the middle of September, when a great and sudden increase occurred, and the amount of organic matter continued large till the end of November, at which time it slightly diminished, and since then, up till January 31st, there has been but little, if any, improvement in the water. This is a point on which I wish to lay great stress, as in respect to it the past season contrasts most unfavourably with the corresponding one of the previous year, for about the middle of November, 1871, the water became exceedingly pure, and continued so till the end of August, 1872. Why did not a corresponding improvement occur on the termination of the past rains? I am assured that there has been no change at the works, that the processes of subsidence and filtration have been carried on in a precisely similar manner both years, while comparison of the analyses of the river-water show that it had the same characters both years during the season under consideration. There has been, indeed, more demand upon the filters in 1872 than in 1871, for, while in round numbers 49,000,000 gallons passed the filters one year, the quantity rose to 61,000,000 gallons during the next; there must therefore have been more rapid filtration, and this, however brought about, must have tended to the deterioration of the water. Further, it seems to me probable that, owing to this stress put upon the filters, especially during the season of flood-water in the river, the suspended organic matter may have penetrated them farther than last year, and may be decomposing in them and adding to the soluble impurity of the water. Moreover, the condition of the settling-tanks is such that they must maintain a considerable degree of impurity in the water. Great as is the advantage in some respects of these tanks, absolutely essential as is the separation of silt which they effect to the mechanical action of the filters, there can be no doubt that they serve as reservoirs which catch and hold an immense quantity of filth, which decomposes in them, and is by-and-by given up to the water, so that the comparatively pure water of the river after the subsidence of the floods is fouled by the stuff which has been deposited in the tanks during the preceding months. But possibly another cause is at work in maintaining the impurity, and I find it in this way. Experiments made in 1871, and recorded in the last annual report, established the fact that the water, after leaving the well at Pultah, purified itself very much prior to its distribution in Calcutta, losing about one-half its organic matter, but experiments made lately show that

nothing of the kind is occurring now, and that the water as distributed in Calcutta contains little, if any, less organic matter than the water before it commences its downward journey. Possibly the flow—about 13 miles in a 42-inch iron main to the Tallah reservoir, and about 3 miles of 30-inch main from Tallah to Wellington Square—may be more rapid this year than last, and this may account in a measure for the difference I have alluded to, but I suspect that the real explanation lies in an accumulation of dirt, either in the main, or in the reservoirs at Tallah or in Wellington Square (this has been discovered at the Tallah pumping-station), which has been yielding up organic matter to the water, and thus counteracting the purification which the water should naturally experience as it flows from Pultah to Calcutta. During August the solid matter in the water was reduced by the operation of the works to one-tenth the quantity present in the water of the river, while the organic matter was reduced to one-sixth, and it was only when the accumulation of silt upon the surface of the filter beds rendered the operations of raking the sand or removal of the surface sand necessary, that the filters became less effective. On two occasions during August and October water was drawn for examination at the same hour on the same day from six hydrants in different parts of the town. The amount of organic matter and of chlorine in the water was found absolutely the same in each sample, proving also the excellency of the processes employed, for it is simply impossible that variations in the quality of the water, and in the accuracy of the manipulations, should have balanced in each case so as to yield the results obtained; I think that there is no accumulation of dirt in the street-mains, and that there is no diffusion of dirty water from the soil into them."

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the treatment of sewage, and of the deposits obtained therefrom. Major-General Henry Young Darracott Scott, C.B., F.R.S., Middlesex. January 14, 1873.—No. 154. I precipitate the sewage water with quick-lime in excess in tank No. 1. The precipitate thus produced is allowed to subside, and to the effluent therefrom I add soluble salts of cheap metallic oxides, such as the oxides of iron or zinc, in sufficient quantity to precipitate in tanks No. 2 the bases of such salts.

Improvements in treating excreta and sewage matters, and in apparatus employed therein, parts of the apparatus being also applicable to the drying and charring of other matters. John Lewis Felix Target, civil engineer, Portdown Road, Middlesex. January 15, 1873.—No. 166. According to this provisional specification, the solid excreta are mixed with a nearly equal weight of charcoal, and about 4 per cent of coal-tar or bituminous substance. The mixture is made into blocks or bricks, which, after being dried, are burnt or charred in a muffle-furnace. The vapours and volatile bodies given off from the bricks become ignited, and the products of combustion are conducted by a flue to heat the boilers of a steam or other apparatus in which the urine is treated. This utilisation, for treating the urine, of the heat given off during or previous to the conversion of the solid excreta into charcoal is an important feature of the invention. The charcoal produced by the burning of the mixture of solid excreta and other substances may be subsequently used as fuel or otherwise. Improved drying houses, muffle-furnaces, distilling apparatus, and other necessary parts are described.

Improved means or arrangements for filtering or feeding lamps with liquid fuel, applicable also to the filtering or feeding of other apparatus used for burning such fuel. J. Hann Maximilian Fleissner, 11, Golden Square, Middlesex. January 16, 1873.—No. 167. This invention comprises a can or receptacle for the paraffin or oil or liquid fuel, provided with injecting mechanism or other means whereby, through the agency of a tube, the paraffin or oil or fuel can be introduced into the body of the lamp (by a suitable opening therein) without interference with the wick or allowing the paraffin or oil or liquid fuel to be exposed to the action of the air.

Improvements in the purification of coal-gas. Major-General Henry Young Darracott Scott, C.B., F.R.S., Middlesex. January 16, 1873.—No. 183. The object of this invention is the removal of sulphur from coal-gas by means of oxide of iron heated to redness in a suitable chamber.

An improved pavement. Robert MacNeill, Lombard Street, London. January 16, 1873.—No. 184. My said invention relates to a pavement which has a foundation of asphalt or other bituminous or tarry substance or compound, and an upper structure or surface of blocks or other suitable material.

SUPPLEMENT TO THE CHEMICAL NEWS.

VOL. XXVII. No. 717.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopaedic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, with their copious indices, will, therefore, be equivalent to an English edition of the "Jaarversichte."

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, July 28, 1873.

New Process for the Condensation of Liquefiable Matters Held in Suspension in Gases.—E. Pelouze and P. Audouin.—The authors point to the existence of tarry matters, ammoniacal water, &c., which are held in suspension in coal-gas as it issues from the retorts, and which cannot be made to deposit even at low temperatures without the aid of costly bulky apparatus. They propose a new method of condensation, which has been already practically tested, founded on the principle that the liquefaction of the globules held in suspension in gases may be obtained either by the contact of these particles with solid surfaces, or by their contact with each other. They obtained the condensation of liquids suspended in gases or vapours by the aid of a very simple apparatus, occupying little space. The gas to be purified passes by a series of narrow apertures in the form of jets, which spread themselves over a surface placed opposite. This arrangement produces a mutual contact of the molecules during their passage through the jets, the efficacy of the action being completed by the contact with the solid surface over which the tarry matter flows. A very high pressure is not needed. The apparatus may be placed either before or behind the exhaustors. The temperature—about 50°—does not interfere with the working of the apparatus. The material may be iron, earthenware, or wood. By this arrangement ammonia, sulphide of hydrogen, and sulphide of carbon may be intercepted.

Respiration of Submerged Aquatic Vegetation.—P. Schützenberger and E. Quinquand.—The method used was titration with hydrosulphite of soda, by which oxygen dissolved in 50 c.c. of water can be determined to 0.005 c.c. or to 0.1 c.c. per litre. The plants experimented upon were beer-yeast and *Elodea canadensis*. Yeast simply absorbs oxygen and produces carbonic acid. All other things being equal the intensity of respiration was alike in the dark, in diffused light, and in direct sunshine. The absorbent power is nearly nil at 10°; up to 18° it increases slowly; from that point it grows rapidly to 35°, where it reaches a maximum which is maintained up to 50°. At 60° the absorbent power is destroyed. Fresh yeast, containing 26 per cent of solid matter, absorbed per gramme and per hour—at 9°, 0.14 c.c. of oxygen; at 14°, 0.42 c.c.; at 22°, 1.2 c.c.; at 33°, 2.1 c.c.; at 40°, 2.06 c.c.; at 50°, 2.4 c.c.; and at 60°, 0.0 c.c. *Elodea canadensis*, like all plants which develop chlorophyll, has a double respiration—(1) absorption of oxygen and production of carbonic acid; (2) development of oxygen under the influence of light. The plant on being heated in water to 45° to 50° entirely loses its power of liberating

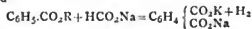
oxygen under the influence of light without its power of absorbing oxygen being affected. The latter phenomenon was found to continue in the light with the same intensity as in the dark; being the result of an independent vegetable function, parallel to the so-called diurnal respiration or disengagement of oxygen. The phenomena of absorption are similar to those displayed in the case of yeast, but about ten times less energetic. The following amounts of oxygen were liberated during one hour by 10 grms. of the plant:—

1. In pure water	c.c.
2. Do. + 2.5 per cent of water saturated with CO ₂	1.0
3. Do. + 5.0 per cent water do.	13.2
4. Do. + 20 to 30 per cent do.	20.0
5. Do. + 40 per cent do.	13.0
6. Water saturated with CO ₂	10.0
	3.0

On leaving an excess of the plant submerged in the sunlight for an hour or two we obtained a liquid supersaturated with oxygen, containing at 35° as much as 20 c.c. of oxygen per litre. This water, when removed from the plant, lost its excess of oxygen with remarkable slowness.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, July 28, 1873.

Action of Formiate of Soda upon Benzoic Acid.—F. v. Richter.—On fusion hydrogen is given off, and the carboxyl groups as they are set at liberty combine partly to form oxalic acid, and in part they act substitutionally. In presence of benzoate of potassa dicarbon acids are formed—



Isomeric Series of the Benzol Derivatives.—V. v. Richter.—A theoretical paper. The author concludes that the constitution of the benzol derivatives is not so certainly established as many chemists assume.

New Constituent of Urine.—F. Baumstark.—The substance in question was found first in the urine of a dog fed with benzoic acid, then in ideric, and finally in normal human urine. Its composition corresponds to the formula C₁₁H₉N₂O. It crystallises in white columns like those of hippuric acid, which melt at 250°, and if heated on platinum foil give off dense white vapours of a peculiar odour. If heated in a narrow tube they yield a combustible gas, which turns litmus blue and smells of ethylamine. The crystals are readily soluble in hot water, sparingly in cold water, insoluble in absolute alcohol and in ether. The new compound forms soluble salts with acids, and does not combine with bases; the solution is precipitated by the nitrate of silver. On treatment with nitrous acid, lactic acid—whose very soluble zinc salts contains 12.1 per cent of crystalline water: it is, therefore, the so-called lactic acid of flesh.

On Chrysin and its Haloid Derivatives.—J. Piccard.—Some years ago the author discovered chrysin—a well characterised yellow colouring matter in the buds of the poplar. (*Bolley's Schweitz. Polyt. Zeitschrift*, vol. ix., p. 137, 1864.) He now enters upon an examination of its properties and its combinations. Chrysin is composed of—

Carbon	70.86
Hydrogen	3.95
Oxygen	25.19
	100.00

corresponding to the formula C₁₅H₁₀O₄. The author has formed and examined its bromide, iodide, chloride, and nitro compounds, and considers it a homologue of alizarin and frangulinic acid.

Certain Constituents of Poplar Buds.—J. Piccard.—Along with chrysin the author has come upon three other

bodies—the ethereal oil of poplar, C_3H_8 ; a mixture of salicin, papulin, and tecto-chrysin, $C_{16}H_{12}O_4$, a higher homologue of chrysin.

Action of Perchloride of Phosphorus upon Pyruvic Acid.—C. Böttinger.—The reaction is violent; on its completion a clear pungent liquid passed over at about 55° to 60° ; which, when mixed with alcohol, gave off an odour of acetic ether. Large quantities of C_2H_3Cl , and of carbonic acid are given off, whilst a dark coloured syrup remains behind containing Climenko's ether. The author appends a preliminary announcement of a new acid obtained from the pyruvic acid.

Chlorinated Derivatives of Acetone.—Albert Theegarten.—The author obtains dichloroacetone by the action of chlorine upon acetone.

Hygroscopicity of the Monophosphate of Calcium.—K. Birnbaum.—The author finds that a portion of pure monophosphate, which—after being dried over sulphuric acid—weighed 1.330 grms. when exposed to the air of the laboratory and weighed daily fluctuated from 1.478 to 1.504 grms. If placed over water the weight rose in three days to 1.876; and on being again exposed freely to the air for three days it fell to 1.501. The same phenomenon, though on a smaller scale, may be observed with superphosphate. By the variable amount of water taken up the percentage of soluble phosphate will be made to fluctuate.

Action of Anhydrous Acetic Acid upon Rhodan-Ammonium.—M. Nencki and W. Leppert.—The authors obtained by this reaction the acid acetytic ether of the bibasic persulpho-cyanic acid— $C_2H(C_2H_3O)_2N_2S_3$.

On Benzyl-toluol.—M. Plaseuda and Th. Zincke.—By oxidising benzyl-toluol with bichromate of potassa and sulphuric acid, the authors obtain benzyl-benzoic acid, and an isomeric body to which they give the preliminary name β -benzol-benzoic acid. This acid crystallises from hot water, in which it is considerably more soluble than the α -acid, in long and broad needles, consisting of aggregations of prismatic crystals. Along with the acids were also formed a hydrocarbon and a keton.

Commercial and the Pure Isobutylic Aldehyde and Isobutylic Alcohol.—G. A. Barbaglia.—The author concludes that the isobutylic-aldehyde, obtained from the Kahlbaum Works (which he had employed in some previous experiments), contains large quantities of acetone, and that the isobutylic alcohol is contaminated with various foreign substances, probably with a considerable amount of isopropyl alcohol. Hitherto no industrial process is known for the preparation of pure isobutylic alcohol, and isobutylic aldehyde.

On Oil of Citron.—A. Oppenheim.—A hypothetical paper. The author pronounces American oil of turpentine and the oil of citron to be both hydromethyl-isopropyl-benzols of the para series.

Critique on the Methods for the Analysis of Water.—Ferd. Tiemann.—(Continuation.)—*Determination of Sulphuric Acid.*—(1). Gravimetric Method.—The amount of sulphuric acid in a natural water can be easily and accurately determined by precipitation with chloride of barium and weighing. The results of this process, which was once considered the most accurate of all gravimetric methods, may readily become inaccurate if the precipitation of the sulphuric acid is performed in a too concentrated solution, and if a too strong solution of chloride of barium be employed. The presence of large amounts of foreign matter, especially alkalis, nitrates, &c., has a disturbing influence, as portions of them are carried down with the precipitate. Finkener even declares that the precipitate is never a perfectly pure sulphate of baryta. In the case of a natural water, however, the circumstances are especially favourable. If the sulphuric acid is thrown down from the boiling water, slightly acidulated with hydrochloric acid, with a very dilute hot solution of baric chloride—using

the further precaution to add first a little of the precipitant, and afterwards a not too large excess—and if the precipitate is allowed time to deposit without filtration, the results may be considered almost absolutely accurate. The only objection is the amount of time required; whence the following methods have been proposed by Weldenstein, and by Boutron and Boudet. Weldenstein precipitates the sulphuric acid by adding an excess of chloride of barium solution of a known strength, and titrating the excess with a neutral solution of chromate of potassa. As large amounts of carbonate of lime have a disturbing influence the water should be rendered acid at the beginning of the experiment, and neutralised again before the addition of the chromate. It is better to boil the water previously, and make it up to its original bulk with distilled water before the determination. The author finds that boiling does not cause the precipitation of sulphate of lime if the loss by evaporation is constantly approximately replaced by distilled water. There is, in Weldenstein's original method, a difficulty in finding the exact end of the reaction. To obviate this 100 c.c. of the water, previously boiled and made up to its original bulk, are heated to boiling in a flask marked at 150 c.c. and to c.c., or if much sulphuric acid is present, 15 to 20 c.c. of a solution of chloride of barium containing 1-10th of an equivalent per litre. After boiling for a few minutes, such a quantity of a corresponding solution of neutral chromate of potassa is added, that when the precipitate settles the supernatant liquid appears faintly but distinctly yellow. When the whole is cold, which is accelerated by setting the flask in cold water, the flask is filled up to the mark with distilled water, the contents shaken and filtered through an unmoistened filter. 100 c.c. of the filtrate are placed in a narrow cylinder of colourless glass, in which the liquid may stand at the depth of 15 to 20 centimetres. In a similar cylinder 100 c.c. of distilled water are then mixed with so much of the standard chromate solution that both exhibit the same tone of colour. The shades produced by 0.1 to 0.6 c.c. of the 1-10th chromate solution can be clearly distinguished. The amount of the chromate added in excess as thus ascertained, multiplied by 8, is deducted from the amount of this solution which has been added to the water under examination. From the difference between the remaining c.c. of chromate, and the c.c. of chloride of barium consumed, the amount of sulphuric acid in the water is readily calculated. In Boutron and Boudet's method the sulphuric acid is thrown down from the boiled water—whose permanent hardness is known—by solution of baric chloride in excess, the value of which is adjusted to the soap liquor. The whole is filtered after the precipitate has settled, and the remaining hardness of the filtrate is determined by the soap-test. If to the "permanent hardness" of the water we add the degrees of hardness corresponding to the baric chloride solution added, and from the sum deduct the hardness of the filtrate, we obtain a value from which the amount of sulphuric acid in the water may be readily calculated. The author proposes the following modification of this method:—100 c.c. of the water previously boiled are heated to boiling in a flask marked at 150 c.c., and mixed in slight excess with a solution of baric chloride, every c.c. of which corresponds to a German degree of hardness. After the precipitate has settled, and the liquid has cooled, the flask is filled up to the mark with distilled water filtered through an unmoistened filter, and the residual hardness is determined in 100 c.c. of the filtrate. In connection with the determination of sulphuric acid the author adds some observations which he has made on grouping together the figures found in the analysis of waters. The permanent hardness of the water, its percentage of sulphuric acid, chlorine, nitric acid, alkalis, and ammonia are here brought into question. In drawing out the results of an analysis of water it is customary to assign the chloride to the alkalis; the remainder of which are calculated as sulphates, whilst the excess of sulphuric acid is allotted to lime and magnesia, as also

the residue of the nitric acid after the ammonia is satisfied. This arrangement is by no means satisfactory with the subsoil waters of populous places. If the supposition on which the above-mentioned arrangements are founded were correct, the total amount of the fixed bases, and the ammonia which is required to saturate the sulphuric, hydrochloric, and nitric acids present, would stand in a definite relation to the ascertained permanent hardness of the water. If we consider the well-known fact that the bicarbonate of lime is not perfectly removed by boiling; and that even after expulsion of all the so-called half-combined carbonic acid $\frac{1}{2}$ of carbonate of lime remains dissolved in 100,000 of water; which consequently make up 2 German degrees of the permanent hardness of every water originally containing bicarbonate of lime. Then on the assumption that the above-mentioned grouping of the several constituents is correct, the permanent hardness of a water may be readily calculated if its percentage of alkalies, ammonia, sulphuric acid, hydrochloric acid, and nitric acid is known. Now the more impure the water, the less do the found and the calculated degrees of hardness agree. It appears that in such cases the excess of water must be combined with organic bases. It is very probable that between ammonia and the original nitrogenous organic bodies there exists a series of transition products possessing more or less decidedly basic properties. If nitric acid exists partially at least combined with organic bases the remarkable phenomenon is explained that spring waters, rich in nitric acid, contain—almost without exception—large amounts of organic matter. But whilst it is highly probable that the nitric acid of polluted wells is not, generally speaking, present as a lime or magnesium salt, nitrates and chlorides of these metals may have found their way into such, or, indeed, into any natural water. A great discrepancy between the amount of sulphuric acid as found, and as calculated from the permanent hardness of a water—in other words, a considerable amount of sulphate of potassa—may be considered as one of the indications of pollution.

Certain Substances of the Camphor Group, and on the Constitution of Camphor.—Aug. Kekulé.—A hypothetical dissertation on the true formulae of camphor, of borneol, campholic acid, campheric acid, carvyl, and carvacrol.

Preparation of Oxy-cymol from Camphor.—A. Fleischer and Aug. Kekulé.—The authors obtain oxy-cymol from camphor by cobination with iodine.

Derivatives of Cymol.—Fr. Landolph.—The author has studied especially the nitro derivatives of camphor-cymol, and obtained α -mononitro-cymol, $C_{10}H_{11}(NO_2)$.

Identity of the Cymols from Camphor, Ptychotis Oil, and Thymol, and on a Second Thio-cymol.—F. Fittler.—The author considers the identity of these cymols demonstrated by his experiments. The new thio-cymol has the composition $C_{10}H_{14}S$.

Action of Perchloride of Phosphorus upon Phenol-Parasulphonic Acid.—Aug. Kekulé.—The products of the reaction, which pass over between 60° and 120° , consist only of thionylchloride and oxychloride of phosphorus. At 265° to 267° a peculiar oil is separated out, whilst the intermediate products, when decomposed with water, yield a large quantity of bichlorbenzol.

Isomeric α and β Derivatives of Naphthalin.—C. Liebermann and Aug. Dittler.—Nitro-naphthylamin, $C_{10}H_7(NH_2)NO_2$, fuses at 191° , is sparingly soluble in water, readily in alcohol, and dyes wool an intense picric yellow. It does not form salts. It is isomeric with Beilstein's nitro-naphthylamin, which melts at 118° to 119° .

Decomposition of Rosanilin by Water.—C. Liebermann.—The author had formerly shown that when rosanilin is heated to temperatures above 240° along with water the atoms of nitrogen are successively eliminated as ammonia and replaced with equivalent amounts of water. He has since succeeded in obtaining the final

product free from nitrogen. It has nothing in common with rosolic or hydrosolic acid. It crystallises in colourless lancet-shaped leaflets. The compound fuses at 200° , and dissolves in dilute alkalies without colour. In water with soda-amalgam it dissolves with a transient red colour, like that which the anthrachinons and other chinons display under similar reducing reactions.

Dibenzyl-Disulpho Acid.—R. Kade.—The composition of this acid is $C_{14}H_{14}(SO_3)_2 + 5H_2O$. The author has examined the lead and barium salts.

On Dipropargyl.—Louis Henry.—A lengthy paper on the compound C_6H_6 , with its reactions and combinations.

Gazzetta Chimica Italiana, Anno III., Fascicolo V. e VI., July 30, 1873.

Researches on Santonin.—S. Cannizzaro and F. Sestini.—The authors have obtained a substance composed of $C_{15}H_{12}O_4$, to which they give the name santonin acid. It is colourless, sparingly soluble in cold, but more freely in hot water, from which it is deposited on cooling in fine prismatic crystals. It is readily soluble in ether, and still more so in alcohol, also in chloroform, and in glacial acetic acid. It melts to a colourless liquid at 161° to 163° . On treatment with alcohol and caustic potassa it does not produce that fine red-violet colouration which characterises santonine. Its acid reaction is very decided, and it decomposes warm solutions of carbonates with brisk effervescence. The authors have further studied the santonates of sodium and barium, and the behaviour of the new acid with bromine and nascent hydrogen.

New Researches on Benzylated Phenol.—E. Paterno and M. Flettli.—In a former memoir (*Gazz. Chim.*, tome iii., p. 121) the authors described the preparation of anthracen from the action of chloride of benzyl upon phenol in presence of zinc, and announced the view that this hydrocarbon owed its origin to a transformation of benzylated phenol. Continuing the study of this substance they found that it can, in fact, furnish anthracen by a very simple reaction when distilled with anhydrous phosphoric acid.

Monochloride of Acetyl.—E. Paterno and G. Mazzara. Monochloride of acetyl when pure is a liquid perfectly transparent, and of a most pleasing odour, and sweetish, burning taste. Its boiling-point is 156.8° , and its sp. gr. is at 0° 1.0418, at 26.3° 1.046, and at 99.9° 0.9315.

Chemical Analysis of Various Wines from the District of Verona.—Prof. Giovanni dal Sie.—A laborious contribution to agricultural chemistry, showing in a tabular form the age of 100 samples of wine, the names of the grower, their physical characters, their locality, the quality of the soil, the kind of grape, the percentage of alcohol, both by weight and volume, the proportion of residue on evaporating at 120° , the ash, the water, and the recorded character of fermentation.

Dry Distillation of the Formate of Lime.—A. Lieben and E. Paterno.—Among the products obtained the authors especially notice methylic alcohol.

The Combustible Fossils of the Province of Siena Applied to Industrial Uses.—G. Campani and C. Giannetti.—("Memoire della R. Accademia dei Fisiocritici di Siena, 1873.) An analysis of three samples of lignite.

Moniteur Scientifique, du Dr. Quenneville, August, 1873.

Researches of the Polymers of Morphia and their Derivatives.—Ludwig Mayer and C. R. A. Wright.—A translation from English sources.

New Procedures for the Manufacture of Coal-Gas.—T. Wills.—A translation from the *Journal of the Society of Arts*.

Theory of Tanning.—M. A. Reimer.—A continuation of the elaborate paper which we have already noticed.

The Regeneration and Restoration of Oil Paintings by Pettenkofer's Method. (A report presented to the Industrial Society of Mulhouse.)—M. Fr. Goppelsröder.—Radlkofer has proved that the deterioration of paintings is not due, as was suspected, to organic formations. It is evident that colours, even the most stable, cannot preserve their original shade and brightness, except on condition that the drying oil, which has interpenetrated them, and in which they are in a manner suspended, retains its optical properties. The most important part of the oils employed by artists is linoleine. This body not being procurable in a state of purity, painters are obliged to use linseed oil in which it is present in the proportion of 80 per cent; or propyl oil, of which it constitutes 75 per cent. Linoleine, originally liquid, solidifies by oxidation without decrease in bulk, but increasing in weight to the extent of 10 per cent. It is then a hard transparent mass, which encloses the colours and the other portions of the oil. It is because linoleine acquires on exposure to the air a consistence invariable at the different temperatures of the atmosphere that the portions of colour when the painting is dry can no longer be displaced, whether by a gentle pressure, or by the fatty and volatile oils and varnishes. As there are, everywhere in the world, atomic and molecular movement, changes physical and chemical take place in paintings. These changes occur more frequently in the oil than in the colour. The colours containing the least oil change most. Pettenkofer's method of restoring pictures is very simple. He makes first a trial on a small scale by means of a round paste-board box, plastered within with strong glue, and the bottom of which is lined with flannel moistened with alcohol at 60 per cent. The box is inverted and placed upon the picture. The part thus treated serves as a guide for the operations on a larger scale. In the latter a box is employed, the bottom of which is lined with flannel, whilst the picture is fixed to the lid. Pettenkofer employs also balsam of copaiba, which is often applied with success to the back of the picture.

On Alimentary Substances in General, and on the Extract of Meat in Particular, Regarded as the Food of Man.—Dr. Max von Pettenkofer.—We extract from this valuable paper the following significant passage:—"It is only a short time ago that it was customary in physiology to speak of a superfluous or luxurious consumption. According to certain physiologists as long as the body is able to perform its functions, even though suffering from hunger, to take more food was luxury. But Bischoff and Voit fully demonstrated by their experiments on nutrition that the result of a nourishment so restricted is a state of want—a continual famine incompatible, in the long run, with the normal conditions of life. The body has need of a certain well-being—of a small excess of nourishment in order to preserve its strength and vigour. What just prevents death from hunger is not sufficient. It is as if we were to restrain the organism from producing any more heat than suffices to prevent death from cold, under pretext that all beyond this limit was superfluity and luxury."

The Farina of Meat and the Salts of Meat.—Dr. Dunkelsberg.—The author points out the importance of mineral salts in the nutrition of animals.

Revue Scientifique de la France et de l'Etranger,
August 16, 1873.

This number contains no chemical matter.

Revue des Deux Mondes, July 15, 1873.

The New Explosives.—M. F. Papillon.—The author estimates the pressure exerted upon a cannon-ball by common gunpowder at 5000 atmospheres. The temperature produced by its ignition he considers to be 2500°. Berthelot's table of the relative heats, volumes of gas, and explosive forces obtained by means of gunpowder,

chlorate powder, gun-cotton, picric acid, and nitro-glycerine is then quoted. (We suspect that Berthelot must have used in his experiments gun-cotton weakened by a considerable amount of dinitro-cellulose.) He gives the highest rank to liquefied protoxide of nitrogen, mixed with ether or other liquid carbides.

Reimann's Färber Zeitung, No. 27, 1873.

This number contains receipts for a scarlet on cloth, in which the following mordant or "spirit" is employed:—12 lbs. bichloride of tin, and 12 lbs. tin crystals dissolved in water enough to form a solution at 36° B. Further, for a yellowish green on cloth, a "May green," a golden yellow; for scarlet, rose, and salmon on woollen yarn, to be produced in succession from the same bath; for a rose shade on wool, for a lemon yellow; a fine black for silk waste; a fine logwood blue (a substitute for a vat blue) upon cotton-wool, and for finishing velvets. The following process for dyeing linen yarn with aniline colours has been patented by Hainisch, of Vienna. The yarn is worked alternately in the two following solutions:—(1) 1 part tannin in 500 parts of water. (2) 1 part glycerin in 32 parts of water, to which egg albumen is added. The yarn remains in each about ten minutes. For very delicate shades No. 1 is omitted. (The only novelty in this patent is its astonishing adacuity.)

No. 28, 1873.

This number contains a notice of the Vienna Exhibition from a colourist's point of view, followed by receipts for an alkali blue on woollen yarn or piece goods; for a new alkali on flannel; for light and dark drab-grey on woollen yarn; heavy black on wool; blue-black, bright blue, sandal-brown, and red-brown on the same; instructions for finishing off velvet after dyeing; grey on leather; coralline-red on cotton; and mat finish for lining-cottons. The editor criticises Lauth's assumption that the dimethyl-anilin used in the manufacture of violet-de-Paris (methyl violet) is perfectly free from toluidin compounds. MM. Lloyd and Green propose to prepare an oil for mordanting yarn and cloth to be dyed Turkey red, by adding, to 1 part of oil, 14 parts of a solution of bleaching soda (hypochlorite of soda at 31° Twaddell). The goods prepared with this emulsion are fit for dyeing sooner than if treated in the ordinary manner.

Revue Hebdomadaire de Chimie Scientifique et Industrielle
par Ch. Mène, May 15, 1873.

This number contains an account of apparatus for heating wines (Pasteur's process), a description of some artistic earthenware, and of a new continuous press for the sugar manufacture. The process of Zettnow for purifying hydrochloric acid is as follows:—The crude acid of sp. gr. 1.6 (that sold in this country rarely exceeds 1.17), and free from iron, is mixed with a little chlorine-water and chloride of lime, to oxidise sulphurous acid if present. It is then stirred up with commercial protochloride of tin (tin crystals), in the proportion of 50 grms. to 10 to 12 kilos. of raw acid, or nearly 2 ounces to 2 gallons. The separation of arsenic and the clarification of the acid are complete after twenty-four hours rest at the temperature of 30° to 35°, and after one to four days at ordinary temperatures. It is then distilled, with the addition of a little common salt and a little sand to regulate the ebullition. The method of Engel, which depends on the use of the hypophosphate of potash, has been already noticed.

Artificial Marble.—G. A. Frear.—This invention consists in the employment of a solution of sulphate and chloride of zinc, sugar of lead, alum, and common salt, mixed in suitable proportions, and dissolved in water to agglomerate the particles of powdered silica, alumina, marble cement, hydraulic cement, sulphate of lime, baryta, and other earthy substances except carbonate of lime.

THE CHEMICAL NEWS.

Vol. XXVIII. No. 718.

ON THE SPECIFIC GRAVITY OF RUBIES AND SAPPHIRES.

By GREVILLE WILLIAMS, F.R.S.

In my paper "Researches on Emeralds and Beryls,"* I stated that the artificial rubies made by me by Gaudin's process, had a lower specific gravity than that of the true ruby. I there assumed the density of the ruby to be 3.53, on the authority of Brisson,[†] and that of the sapphire as 3.56, according to Muschenbroek.[‡] Having occasion, in extending my experiments on the subject, to take the specific gravity of several rubies and sapphires, I found their density to be very much higher than the numbers given in Gemelin's "Chemistry." On referring to other works,^{||} I found the numbers given in them to be generally between 3.9 and 4.0; Professor Church also found a blue sapphire to have a density of 3.979, and a yellow one 4.030. My own determinations, made upon very fine stones, gave me for rubies 3.95, and for sapphires 3.98. Assuming 3.95 as the average specific gravity of the ruby, it will be seen that Gaudin's rubies as first made by me were 0.5 lower in density than the native ruby, instead of 0.08 as given in my former communication. I have, however, recently succeeded in preparing some fresh specimens of artificial rubies by the same process, but with a higher density, namely 3.7; this number is only 0.25 lower than the native ruby, and I think it probable that the true density of the ruby might be attained if the frothing, which takes place to a greater or less degree under the intense heat of the oxyhydrogen blowpipe, could be completely avoided.

THE CHEMICAL CONSTITUTION OF SUCCINIC, MALIC, AND TARTARIC ACIDS, CRITICALLY EXAMINED AND INTERPRETED FROM THE STAND-POINT OF THE "TYPO-NUCLEUS" THEORY.

By OTTO RICHTER, Ph.D.

(Concluded from p. 91).

PART III.

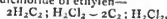
On the Principal Molecular Changes that Accompany the Artificial Production of the Water-Salts of Succinic, Malic, and Tartaric Acids in our Laboratories.

UNDER this head a number of interesting cases have fallen under my notice, out of which I shall select the following four:—The first case refers to the artificial production of the ortho- and iso-succinate, which, according to Byk and Wichelhaus, may be got by boiling the corresponding varieties of cyan-propionate with potash ley. The second case refers to the artificial production of the ortho-succinate, which, according to Simpson, may be got by boiling the di-cyanide of ethylen with potash ley. The third case refers to the artificial production of the ortho-tartrate (the inactive form), which, according to Debus, is generated on treating a mixture of glyoxal and hydrocyanic acid with solution of potash. The fourth case refers to the artificial production of the ortho-tartrate (the

racemic variety) which, according to Heintz, is found among the products of oxidation of the ordinary glycerate of water.

The proper discussion of the first case renders it incumbent on me to examine more minutely into the chemical origin and constitution of the nitrogenous substances that form the basis of these experiments.

In the first place, as regards the cyan-propionate. This compound, which gives rise to the ortho-succinate, may be prepared by the following method:—When ethylen, $2H_4C_2$, is exposed to the action of phosgen gas, $2C_2Cl_2O_2$, the product of their direct union is the chlor-propionyl chloride, and the molecular changes attending its formation are believed to be as follows:—In the first stage, the phosgen splits up into carbonic oxide and free chlorine, which, by an action strictly analogous to that of oxygen (*vide* Part I.), effects the conversion of the ethylen into the biatomic dichloride of ethylen—



In the second stage, the methylen adjunct of the latter parts with its 2 mols. of hydrogen, which are oxidised into 2 mols. of water at the expense of the carbonic oxide, but these 2 water mols., instead of being eliminated, are instantly brought to bear upon the residual carbon nucleus, so as to give birth to a mol. of formite of water. In the third stage, the formous acid constituent of this latter enters into chemical union with the dehydrogenated dichloride of ethylen, with production of the chloride in question, the chemical constitution of which is, therefore, expressed by the formula—



In contact with water, this substance becomes speedily decomposed into hydrochloric acid and the chlor-propionate—



which, by treatment with cyanide of potassium, &c., becomes finally converted into the cyan-propionate—



In the second place, as regards the iso-cyan-propionate. This compound, which gives rise to the iso-succinate, may be prepared by the following method:—When 1 mol. of iso-lactate (ordinary lactate) of lime—



is acted upon by 2 mols. of perchloride of phosphorus, it becomes transformed into the iso-chlor-propionyl chloride—



In contact with water, this substance readily decomposes into hydrochloric acid and the iso-chlor-propionate—



which, by treatment with cyanide of potassium, &c., becomes finally converted into the iso-cyan-propionate—



Let us further contemplate the molecular changes, which attend the conversion of these two isomeric varieties of cyan-propionate into the corresponding succinates. The copious evolution of ammonia in both cases clearly shows, that the alkali has effected the decomposition of these bodies into the lactate (so-called para-lactate, and identical with the glyceric aldehyd of Socioffo) and into the iso-lactate, while the liberated hydrocyanic acid has been made to resolve itself into ammonia and formate of water.

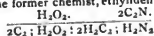
* *Proc. Roy. Soc.*, 1871, No. 745, p. 409.

† Gemelin's "Chemistry," Cavendish Society's translation, vol. iii., p. 304.

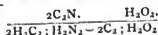
‡ *Loc. cit.*

|| Brooke and Miller, "Watts's Chem. Dict.," "Rammelsberg," &c.

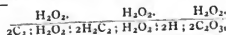
Before proceeding farther, and with the view of still more fully confirming my conception of the molecular structure of lactic and iso-lactic acids, I have deemed it advisable to interlace an analysis of the principal molecular changes which accompany the artificial production of these two isomerides. I allude to the beautiful synthetic processes, devised by Wislicenus and Lippmann, whereby, according to the former chemist, ethylen cyan-hydrate—



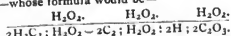
is converted by ebullition with potash into a salt of iso-lactic acid, while, according to the latter chemist, ethylen cyan-hydrate—



is transformed under similar circumstances into lactic acid. Now, on the principles which guide me in the interpretation of chemical phenomena, the ethylen cyan-hydrate ought to give rise first of all to the intermediate product—

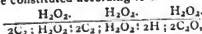


which, through the loss of 2 mols. of water, caused by the splitting up of the colligated formylic alcohol, and the coalescence of the liberated formen with the methylen adjunct, changes afterwards into the iso-lactate, whereas the ethylen cyan-hydrate ought to furnish the lactate directly—that is, without formation of an intermediate product—whose formula would be—



I have, indeed, good grounds for affirming, that the kind of molecular arrangement implied by this latter formula, whereby an olefine-begotten polyatomic alcohol is made to discharge the functions of a halogen adjunct, is a chemical incongruity, but that the obstacle to chemical union is removed by the conversion of that alcohol into the corresponding de-alcohol.

Reverting, again, to the intermediate product preceding the formation of the iso-lactate, a remarkable and highly instructive contrast is brought to light by the following train of reasoning:—Observe, first, that the colligated alcohol of that product is the mono-acid, but still biatomic ethylen glycol or glycolic alcohol, while the colligated alcohol of the other and, as I believe, impracticable transition product, is the biacid and biatomic ethylen glycol. Observe, in the second place, that if in the above reaction the methylen adjunct of the glycolic alcohol had experienced, at the expense of the associated formic acid principal, a water-producing process of dehydrogenation, similar to what the same adjunct is supposed to have undergone in the ethylen glycol, the resulting compound ought to be constituted according to the formula—



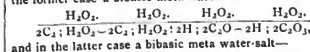
which shows it to be a new isomeride of lactate of water, of the real occurrence of which I myself have not the slightest doubt. But, considering that the actual product obtained is the iso-lactate of water, whose formula rests upon the concordant testimony of a great variety of analyses, the conclusion seems to me inevitable, that the typical metamorphosis, which the ethylen-glycol has experienced in the act of passing into the isomeric glycolic alcohol, is sufficient to protect the methylen adjunct against the rigorous enforcement of a law, which demands the unconditional surrender of two hydrogen molecules on the part of the olefine adjunct of a given mono- or polyatomic alcohol, before it can be admitted into chemical fellowship with a given acid principal.

This subject may be fitly concluded by appending a list of all the theoretically-possible isomerides of lactate of water, several of which have now been obtained in a state of isolation.

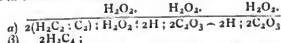
Table of the Theoretically-possible Isomerides of Lactate of Water.

- | | $\text{H}_2\text{O}_2.$ | $\text{H}_2\text{O}_2.$ | $\text{H}_2\text{O}_2.$ |
|--|-------------------------|--------------------------|--------------------------|
| 1) Lactate, $2\text{C}_2; \text{H}_2\text{O}_2 - 2\text{C}_2; \text{H}_2\text{O}_2; 2\text{H}; 2\text{C}_2\text{O}_3.$ | | | |
| 2) Iso-lactate, a) $2(\text{H}_2\text{C}_2; \text{C}_2); \text{H}_2\text{O}_2; 2\text{H}; 2\text{C}_2\text{O}_3.$ | | | |
| β) $2\text{H}_2\text{C}_4;$ | | $\text{H}_2\text{O}_2.$ | |
| 3) Para-lactate, a) $2(\text{H}_2\text{C}_2; \text{HC}_2); 2\text{C}_2\text{O}_3.$ | | | |
| (oxypropionate) β) $2\text{H}_2\text{C}_4;$ | | $\text{H}_2\text{O}_2.$ | $\text{H}_2\text{O}_2.$ |
| 4) Kata-lactate, $2\text{C}_2; \text{H}_2\text{O}_2; 2\text{C}_2; \text{H}_2\text{O}_2; 2\text{H}; 2\text{C}_2\text{O}_3.$ | | $2\text{H}_2\text{C}_2.$ | $\text{H}_2\text{O}_2.$ |
| 5) Methyl-glycolate, $2\text{C}_2; \text{H}_2\text{O}_2; 2\text{H}; 2\text{C}_2\text{O}_3.$ | | $\text{H}_2\text{O}_2.$ | $2\text{H}_2\text{C}_2.$ |
| 6) Glycolate of methyl, $2\text{C}_2; \text{H}_2\text{O}_2; 2\text{H}; 2\text{C}_2\text{O}_3.$ | | $\text{H}_2\text{O}_2.$ | $2\text{H}_2\text{C}_2.$ |
| 7) Aceglycolate, $2\text{C}_2; \text{H}_2\text{O}_2; 2\text{H}_2\text{C}_2; 2\text{C}_2\text{O}_3.$ | | $\text{H}_2\text{O}_2.$ | |

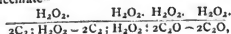
Let us now, after this somewhat lengthy, but, I trust, not unwelcome digression, resume our inquiry into the nature of the molecular changes which accompany the artificial production of the succinate and iso-succinate at the point where it was said that the action of the alkali upon the two varieties of cyan-propionate had given rise to two varieties of lactate, besides ammonia and formate of water. In the second stage, the formic acid constituent of this water-salt unites as ally with the formous acid principal of the lactate on the one hand, and with the formic acid principal of the iso-lactate on the other hand. The resulting compounds are, therefore, in the former case a bibasic meta water-salt—



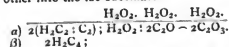
and in the latter case a bibasic meta water-salt—



The third stage is characterised by the splitting up of these two isomeric water-salts into 2 molecules of water and the corresponding meta-anhydrides, which, by the method of ortho-genesis, are finally transformed, the one into the ortho-succinate—

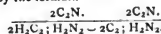


and the other into the iso-succinate—

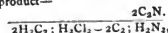


It will be seen on comparison, that these two formulae agree completely with those I have already, but on different grounds, been brought to regard as the true exponents of the chemical constitution of the two isomerides in question.

Let us now examine into the second case, which refers to the artificial production of the ortho-succinate from the dicyanide of ethylen, the chemical constitution of which is expressed by the formula—



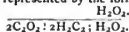
It is clear that the formation of this latter compound from the dichloride of ethylen must be preceded by an intermediate product—



which, by treatment with potash ley, ought to furnish the above-mentioned chlor-propionate; while, under the same circumstances, the dicyanide ought to give rise, in the

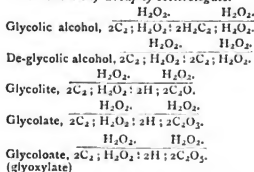
first instance, to the above-mentioned cyan-propionate, for the rationale of whose conversion into the ortho-succinate it is, therefore, sufficient to refer the reader to the explanations given under the head of that compound.

The third case has for its object the artificial production of the ortho-tartrate of water* (the optically-inactive variety), the proper comprehension of which necessitates, however, a previous acquaintance with the molecular structure of the so-called glyoxal. According to my researches, this aldehyd-like substance is the lowest acid heterologue of an organic family group, whose unknown parent alcohol is represented by the formula—

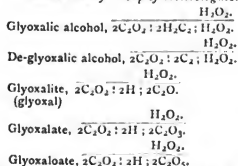


The following scheme exhibits two closely related organic family groups, headed by their respective parent alcohols, and so arranged as to illustrate the complete parallelism of the two series:—

First Family Group of Heterologues.

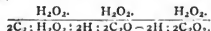


Second Family Group of Heterologues.



N.B.—It deserves to be specially noticed, that the glyoxalate, as well as the para-oxalate previously alluded to, are bimeric modifications of the ordinary oxalate.

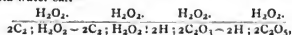
With the aid of this scheme, the whole process may now be explained in the following terms:—In the first stage, the glyoxalite becomes converted into the glycolite, the 2 molecules of hydrogen required for that purpose being, as usual, derived from 2 water molecules, whose oxygen serves to transform into a molecule of formate one of the 2 molecules of formate that were generated by the action of the alkali on the two accessory hydrocyanic acid molecules, while the other molecule of formate of water enters into chemical union with the freshly-formed glycolite. The product of this union, viz., the bibasic meta-glycerate—



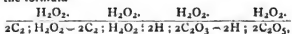
merges afterwards into the isomeric modification of the monobasic glycerate, but in the act of doing so an opportunity is afforded to the acid constituent of the aforesaid formate of linking itself to the formic acid principal of

* The reader will bear in mind, that in my system all variations in the optical properties of a given molecule, so far from being due to differences of molecular grouping, are held to depend entirely and exclusively on the symmetrical or unsymmetrical distribution of the atomic vibratory movements around the three principal crystallographic axes of that molecule.

the glycerate. It will be seen that the resulting bibasic meta water-salt—



is absolutely identical with the transition product encountered in my analysis of the slow and gradual oxidation of the butylen-erythrol; it will, therefore, agree with the latter in resolving itself into 2 molecules of water and the ortho-tartrate in question. The fourth, and last, case has for its theme the artificial production of the ortho-tartrate from the ordinary glycerate. According to Heintz, the oxidation of this compound gives rise, amongst others, to the water-salts of formic, glycolic, glycolic, and tartaric acids, while carbonic acid is given off. The simultaneous appearance of these substances is easily accounted for on the hypothesis that the monobasic glycerate, after merging into the isomeric form of the bibasic meta-glycerate, splits up into 2 molecules of water and the tartrate, which soon resolves itself into carbonic acid and the glycolate, whence the glycolate is finally obtained by the union of the latter with 2 molecules of oxygen. In the next stage, the glycolate breaks up into the formic alcohol, which is speedily oxidised into the formate and into the formate, the acid constituent of which unites as ally with the formic acid constituent of the meta-glycerate, while it is in the act of re-assuming the monobasic form of grouping. Hence the resulting combination will be expressed by the formula—



which is again, as in the preceding case, absolutely identical with that remarkable transition product which was shown to be the immediate precursor and originator of the ortho-tartrate under consideration.

It cannot be denied, that the synthetical formation of organic compounds belonging to that distinguished family circle, which owns the tartrate for one of its most highly oxidised acid heterologues, is a fact of the deepest import and significance; and certainly, when I consider the great compactness, cogency, and coherence which competent judges will do me the justice of enumerating among the commendable qualities of my peculiar method of reasoning, I would fain persuade myself that my researches have revealed the true *modus operandi*, according to which the carbon-nuclei of one, two, or more molecules of hydrocyanic acid, originally introduced into a given molecule as non-essential elements, or co-existing in the same solution, and in close proximity to that molecule, may become permanently incorporated therein as essential elements. The reader is no doubt aware that several curious and interesting cases of this kind have recently been put on record, among which I may mention the artificial production of the ortho-pyrotartrate from the dicyanide of propylene, the iso-pyrotartrate from the iso-cyan-butylene, and the carballylate from the tricyanide of allyl. A full discussion of these and other analogous cases is reserved for my paper "On the Chemical Constitution of Citric Acid and its numerous Derivatives," where I hope still more emphatically and conclusively to demonstrate the general soundness and validity of this entirely novel, but as yet practically untested, section of my "typo-nucleus" theory.

It is now time to take temporary leave of my subject, which, so far from being exhausted, may yet be contemplated under a variety of aspects and conditions. Among these, I may single out in particular the action of bromine on our three acid heterologues, the rationale of which I purpose communicating in one of my next papers.

Finally, and in conclusion, I have deemed it advisable, for the special consideration of those who may desire to prosecute their chemical studies in the spirit of the "typo-nucleus" theory, of appending the following two schemes, for the proper interpretation of which I must refer the reader to the subjoined explanatory note.

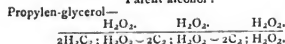
GENERAL GUIDE.

Water-salts.		Affixes.				
		-ite.	-fite.	-ate.	-ate.	-ate.
Monobasic	—	1	3	5	—	5
Bibasic	{ Meta series	1-3	3-3	3-5	5-5	—
	{ Ortho series	1-1	1-3	3-3	3-5	—
Tribasic	{ Meta series	1-1-3	1-3-3	1-3-5	3-3-5	3-5-5
	{ Ortho series	1-1-1	1-1-3	1-3-3	3-3-3	3-3-5

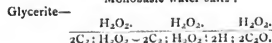
FIRST SCHEME.

Triatomic System.

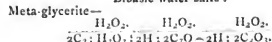
Parent alcohol :



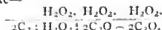
Monobasic water-salts :



Bibasic water-salts :



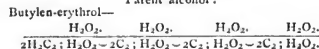
Ortho-glycerite—



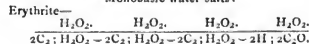
SECOND SCHEME.

Tetrameric System.

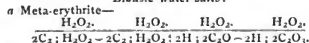
Parent alcohol :



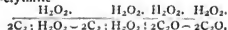
Monobasic water-salts :



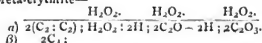
Bibasic water-salts :



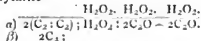
b Ortho-erythrite—



b Meta-erythrite—



c Ortho-erythrite—



NOTE.—Let it be understood that the name given to the lowest heterologue of each component group of bibasic or tribasic water-salts is compounded of a prefix, a root, and an affix. The prefix consists of the words *meta* or *ortho*, implying that the molecule is moulded on the formyl type or on the oxaly type; the root is contained in the name of the parent alcohol; and the affix consists of the syllable *ite*. In the "general guide" this syllable is followed by a given number of affixes, by the substitution of which for the first we are enabled to designate the higher or more oxidised members of each component group. Finally, sets of figures, linked together by twos or threes, and placed below each affix, serve to indicate the relative number of oxygen molecules contained in the acid principal and associated allies of the corresponding bibasic or tribasic water-salts.

ON THE ENERGIES OF THE IMPONDERABLES,
WITH ESPECIAL REFERENCE TO THE
MEASUREMENT AND UTILISATION OF THEM.*

By the Rev. ARTHUR RIGG, M.A.

(Continued from page 93.)

As an illustration of this principle of least action, look at that most extraordinary muscle of all in the animal economy—the heart. Although certain features of its action should come under notice at a later portion of the evening, yet it bears upon the present subject, in that it is a bundle of small muscular fibres. There are probably more than a million of them, complex in their arrangements and perplexingly curious in their relative and combined actions, and yet this, regarded as one muscle, weighs on an average, in man, only 9·39 ozs. Its screw-like construction is such that at each action it propels forward the whole of its contents, leaving no filled-in corners. It has power to propel these contents to the vessels in the extremities of the body. Were not this muscle "up to the mark," these extremities would die for want of nourishment; if, "beyond the mark," then some of the vessels along which the blood is driven might be burst in consequence of a liquid pressure greater than that they were calculated to sustain.

The balances required are perfect, and this little muscle of 9·39 ozs. sends life to all parts of the body—by day and by night—from birth to death. Now the work it is continually performing is as though it lifted its own weight through nearly 20,000 feet in an hour. The height of St. Paul's Cathedral, from the ground to the top of the cross, is 404 feet; therefore the heart could place itself on the top of St. Paul's Cathedral nearly fifty times in one hour. Let a man consider how often in an hour he could ascend, even on the assumption that he was never tired, and then he may obtain an idea how much more work his heart is doing than he can do. Put otherwise, the heart, regarded as we regard a locomotive, can raise itself through a vertical height of nearly 4 miles in one hour. The most powerful locomotives, built specially for the ascent of gradients, can only raise their own weight through about half-a-mile, or one-eighth of that which the heart can do. The directors of an Alpine railway (that from Trieste to Vienna) offered a prize for the locomotive which could lift its own weight through the greatest height in one hour. It was allotted to the locomotive (Bavaria), which lifted its own weight in one hour through 2700 feet, or about half-a-mile. The experiment was simply made by means of inclines or railway lines; the subject this evening does not warrant a larger reference to this matter.

By no contrivance can we make a machine which shall bear such proportions between size and work as the heart does. Here is a little machine, weighing say 10 ozs., put in action and worked by vitality, as a steam-engine is worked by heat; and this little engine, which we could easily put in our pockets, can lift itself 20,000 feet high in an hour. There must indeed have been a master-mind that designed and executed the manufacture of the animal machinery, and so perfectly carried out the "principle of least action."

By careful anatomical and mathematical investigations similar to those which are to be alluded to near the close of this lecture, the daily work of the heart can be shown to be 124 foot-tons. This is nearly one-third of the daily labouring force of the whole body.

This muscle of the heart is not only capable of exerting this wonderful power through the action of the vital force, but it seems not to need any rest, and yet it does not wear out, for the muscles in the heart of an old man are apparently as sound and healthy and fit for continuous

* The Cantor Lectures, delivered before the Society of Arts.

work as those in the heart of a youth. How through life they have been so maintained, how as other muscles in the frame lose somewhat of energetic power, yet these fail not, is one of the many perplexities to science. That muscular power is, as we may say, restored by rest and food, any one who cares to think upon what he experiences and witnesses will readily admit; indeed, further, the nature of the work and the character of the food must be suited each to the other. Now the muscles of the heart never rest. The variation in their energy is within very narrow limits, so narrow that we may say that any series of observations, however long continued and whenever taken—as a series—would always average the same result. Hence the inference that in the animal economy these muscles possess the power (peculiar probably to themselves) of at one and the same time parting with energy and restoring it. This ever-balanced and ever-exerted energy, this actual external utilisation of energy, coupled with a perfectly self-recuperative operation, is what the searcher for perpetual motion, like the asymptote to the hyperbola, is ever approaching, but never attaining.

If men can find out how these particular muscles are exempted from the laws of muscle, with which laws these Cantor Lectures are mainly concerned, they will have advanced further in solving the problem of perpetual motion, which some enthusiast in every generation pursues with commendable, but hitherto unsuccessful, zeal.

The energy of vitality, as utilised and controllable by ourselves, is chiefly through the agency of muscles. The physiologist regards these muscles, with their attached tendons and nerves, as to the functions and offices they discharge in the economy of the individual; we are to regard them as to the external use to which they may be applied, and the work to be obtained from them. How much we copy from Nature may be concluded when we refer to the earliest attempt at locomotion from machinery. It was by basing the form and structure upon the muscles of animals. To thus imitate muscular action has hitherto baffled the ingenuity of man. If anyone has not satisfied himself of the nature of this action, let him put the hand on the muscles of the arm when it is in repose; they are soft and yielding. Let him now make an exertion with the arm, such as raising a weight; the muscles become tense and hard. The weight raised is extraordinary compared with the weight of muscle employed, for it may be from 16,000 to 17,000 times its own weight.

The physiologist considers the striated and unstriated variety of muscle, the nucleated cells, the vitality in each cell, the electrical relations of various tissues. With none of these need we be concerned.

Engineers regard muscles as machines for doing work, and, as it is needful to know the structure of a machine before we can say how it can be made to work, so now the structure of muscle, as a machine, must be considered.

When a muscle is examined after vitality has ceased, it is found to consist of a great number of separate parts, or strings. If this piece of string were a muscle, there would be a bundle of strings or fibres together—just the same as if I had doubled the string several times,—and encasing them there is a covering or sheath, much the same as an india-rubber tube, which covering encloses a number of muscular fibres or strings. That covering has none of the contradile elements of the muscle in it; it is merely an elastic covering enclosing that which has the contradile powers. Then, side by side with this bundle of fibres or strings, in its case, is another one, also covered in the same way, and another, and another. These are kept in their place by the tubing or covering spoken of, and a combination of these is called a muscle, which consists, then, of these fibres, which, again, are separated into fibrillæ. With such a peculiar arrangement of contradile strings, it is clearly a problem for the mathematician and the mechanic to obtain a

solution to the question of how much work can vital energy do when operating through the means of such apparatus as is thus supplied. The muscles are so varied in form, combination, and number, that but little progress has hitherto been made to deduce results and bring them into measurement.

Now, no substance is known that can act the part of a muscle. A muscle left free is in the state of an india-rubber band when slightly stretched. It is called into action by contracting—exactly the converse to that of india-rubber, which is brought into action by being stretched. A number of these fibres are put together, and form a group like a number of india-rubber bands. Sometimes the groups act in a straight direction, sometimes they take a sloping form. If they take a straight form, and if we know the number of fibres and the power of endurance of one, it is easy to calculate the power of the whole; but, if the muscle acts diagonally, then it brings in the parallelogram of forces, and we need the mathematician to deduce the amount of energy which can be utilised by this form. Sometimes the fibres are twisted like a screw, sometimes they spring from one point and spread out like a fan, and all these screws and fans the mathematician must get hold of and calculate; this is now being done.

Having endeavoured very briefly to explain the mode in which animal vitality can be utilised through the agency of muscle, it may perhaps be well to state that between that part of the system where the will is localised and the muscle, there are telegraphic ramifications of nerves. These nervous processes enter within the muscle, and, by some means unknown to us, influence the muscle to exert its mechanical powers—convey, in fact, the will to that agent which is expected to do its bidding through the power introduced by vitality.

With this nerve power we are not concerned. The nerve as a material substance is intermediate between the will and the muscle; it has nothing to do with the amount of work done; its business is chiefly to connect the mental and the material processes of life. Of that which is the will, of that which travels along the nerve in consequence of the will, we know nothing. Call it electricity; that is not any advance, for we know nothing of what electricity is. The first region in which the vital power gives a measurable evidence is when the muscle begins to act. Prior to that all is speculation, and furnishes a very pleasant hunting-ground for physiological enthusiasts.

Whether muscle is a means or apparatus for the transformation of force, or whether it is the material out of whose chemical changes or electrical states force and consequent energy result, are beyond our present knowledge. A plant transforms light into energy; so may muscle transform what, for want of a better name, may be called vitality into energy, and yet not be itself consumed or destroyed. Although, for obvious reasons, that energy which is localised in animals is called the energy of vitality, yet it must not be inferred that such energy or source of energy is self-existent. The animal extracts it in those wonder-working laboratories, the stomach and the lungs. By some unknown process it is deposited in the muscle as potential energy, and awaits the decision of the will as to when and how it shall become kinetic. Although ignorant of the analytical chemistry of vitality, yet we are not ignorant of the materials with which it experimentalises. With this knowledge we must rest; we cannot repeat the experiments vitality makes. Given every material and contrivance within reach, neither the physicist nor chemist, separately or jointly, can accomplish the phenomena with which the changes of these ingredients are concerned when they are associated with the vital principle.

To form an estimate of the number of the fibres in any muscle is an investigation requiring more of care and caution than of difficulty. Determining from a series of averages the magnitude of one—i.e., the area of cross section of one muscular fibre,—and knowing the area of

the section of muscle, the number is merely the quotient of the division.

The muscles are exceedingly small and delicate, and the way their size is calculated is by cutting a piece of cardboard exactly to the section of the muscle. Then another piece is cut out of the same cardboard to, say, a square form, and they are weighed against each other until the square card is exactly the weight of the irregular piece. Thus, when the weights are equal, the areas are equal, and, by calculating the area of the square piece, you are able to arrive at the area of the section of the irregular muscle. By the aid of a powerful microscope, we can ascertain the size of a section of one of these fibrillae, and it is found to be in men $\frac{1}{100}$ th of an inch in diameter, so that in an inch there would be 350 of them; in women it is about $\frac{1}{120}$ th, i.e., in 1 inch there would be 450 of them. It may here be mentioned that these elementary fibres are not circular, but polygonal, owing to their mutual pressure, and at the angles of the polygons are the vessels which supply blood. Hence it obviously follows that where these fibrillae are very small, the supply of the blood, which is the food of the muscle, can get at them more readily than when they are very large. When they are large they have greater strength, that is, can lift heavier weights, but where they are small they will have greater endurance, because more freely and easily supplied with blood. Hence, as they are smaller in women than in men, the muscles of women have more power of endurance, but not the same strength as those of men. If a man wishes to test this, he has only to nurse a child, and then compare the length of time he could do so without fatigue with the length of time for which a mother can nurse it, and he will soon find the difference, and give a verdict adverse to himself.

There are two muscles in the arm, with which we are especially concerned in estimating the measurement of such vital energies as we may utilise; indeed, it may suffice to consider that the muscles in the arms and legs are the only ones to which the subject of this evening's lecture directs attention, and we may illustrate the question of the great number of muscular fibres by calculating, in the mode described their presence in the two most important muscles in the arm—viz., the one called "biceps," the other called "brachialis anticus." In the biceps there were found to be 449,000 elementary fibres; in the brachialis there were found to be 349,000; total, in these two muscles of the arm, 798,000 fibres.

(To be continued.)

NOTICES OF BOOKS.

Programm der K niglichen Rheinisch-Westf hlischen Polytechnischen Schule zu Aachen f r den Cours 1873-74.

Announcement of the Stevens Institute of Technology, a School of Mechanical Engineering founded by Edward A. Stevens. Hoboken, N.J., U.S.A. 1873.

WE owe to the courtesy of the directors of the establishments just alluded to the opportunity of calling attention to two excellent schools established, the one by the care of the Prussian Government, the other by the munificence of a late eminent citizen of the great Transatlantic Republic.

In the Programme of the Polytechnic School at Aachen (Aix-la-Chapelle) we meet with a very clear and succinct review of polytechnic science in all its bearings and applications, as taught by a staff of some forty teachers, while the headings of the various subjects in which instruction is given amount to about one hundred. The school is now attended by about four hundred pupils, many of whom are natives of non-German countries.

Although an institution due to private munificence, the Stevens Institute of Technology can worthily vie with the now already celebrated School at Aachen. The Stevens

Institute is just as much a high polytechnic school as the German one, and to the eminent President of the American school, Dr. H. Morton, high credit is due for the manner in which he has assisted the trustees of this foundation to carry out the will of the late Mr. E. A. Stevens.

Our space does not permit us to enter into a detailed review of the two volumes, the titles of which are recorded above. Both books have a permanent value, and the American contains, aided by woodcuts, a description of some of the most prominent portions of the contents of the museums and collections of apparatus for illustrating lectures on physical, chemical, and engineering sciences. While calling attention to these institutions, we cannot but express our great regret that in this country nothing exists which even approaches either of the two establishments of which the programmes have been courteously sent to us.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopaedic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des S ances de l'Acad mie des Sciences, August 4, 1873.

Reciprocal Displacements among the Hydracids.—M. Berthelot.—It is known that the reciprocal displacements among the hydracids are generally the reverse of those which take place among the corresponding elementary bodies. Chlorine expels bromine from bromides, which in turn drives out iodine from iodides, whether soluble or insoluble. But hydrobromic acid decomposes chloride of silver and alkaline chlorides, and hydriodic acid decomposed both the chlorides and bromides of silver, and of the alkaline metals. There is a similar contrast with oxygen and sulphur. This reversion of phenomena the author explains by the reversion of the thermic sign of the reactions. He has examined, both from a chemical and thermic point of view, the reactions of hydrochloric, hydrobromic, hydriodic, hydrocyanic, and hydrosulphuric acids upon oxides, and upon alkaline and metallic salts, as well as their reciprocal displacements. He finds that the thermic action of the three halogens gives place to reactions more closely alike to each other in case of silver than of potassium. The resemblance is still closer with mercury. It cannot be admitted that the mutual substitution of halogens gives rise in general to thermic effects which are constant, or even multiples of one common constant. On the contrary, such an approximate constancy exists with the salts of the alkaline metals, and with the acid chlorides, bromides, and iodides derived from certain non-metallic elements or organic compounds.

Polychromic Photography.—L. Vidal.—The process by which the author has obtained polychromic images is an extension of the "carbon process," described in his application for a brevet, December 23, 1872. Forstearine paper he has substituted a vegetable paper coated with gum-lac. Polychromic proofs may be obtained either by optical means more or less precise, and analogous to those described by Ducos du Hauron, or by reserving on each of a series of monochromatic proofs all the parts which ought to contribute, by a greater or less degree of transparency, to the formation of the monochrome. In copying nature, if it is desired to produce the red monochrome,

everything is covered with an opaque resist, such as vermilion or lamp-black, which contains neither red nor combinations of red with other colours. A similar process is repeated with blue and other colours. Each of the proofs concurring in the formation of a polychromic plate is then printed on a mixture of the desired colour, and developed on a provisory support.

Analysis of Dewalquite from Salm Chateau in Belgium.—F. Pisanl.—This mineral has been known also under the names of ardenite and mangandisthen. Its composition is—

Silica	28.40
Alumina	24.80
Ferric oxide	1.31
Manganic oxide	25.70
Lime	2.98
Magnesia	4.07
Oxide of copper	0.22
Arsenic acid	6.35
Vanadic acid	3.12
Water, and loss on heating	5.20

102.15

On Nitrication.—Th. Schliesing.—(Continuation.)—If there is no oxygen in the atmospheric air confined in the soil it becomes a reducing medium, and the nitrates are doubtless destroyed, though the nature of their products of decomposition is not known. Kuhlmann has proved that nitric may be converted directly into ammonia. On the other hand, liquids of organic origin—such as the juices of beet-root, tobacco, or urine—yield a variable mixture of protoxide and binoxide of nitrogen, and free nitrogen. The decomposition products of the nitrates are therefore not constant, and depend on the nature of the surrounding medium. The mode of the decomposition of the nitrates, when the medium is a soil deprived of oxygen, has not been examined, and is a very interesting question. Earth of known composition mixed with known amounts of nitrates, and kept from November 20, 1872, till January 24, 1873, at temperatures ranging from 14° to 22°, showed that the reduction of the nitrates had not yielded 1-15th of the ammonia which would have been its equivalent; on the contrary, there is disengagement of free nitrogen. In another experiment earth kept in an atmosphere free from oxygen lost as much nitrogen as was originally present in the form of nitrate, and even more. Boussingault has shown that in a confined oxygenated atmosphere gaseous nitrogen does not contribute to the formation of nitric acid in soils; but that these, on the contrary, lost a portion of their combined nitrogen. The author finds the same result in an atmosphere void of oxygen.

Corundum of North Carolina, Georgia, and Montana.—Lawrence Smith.—In North Carolina corundum is found in rocks of chrysolith or serpentine, lying parallel to and on the north-west side of the main mass of the Blue Mountains. On the beds of serpentine are found chalcodone, chromite occasionally, chlorite, talc, steatite, anthophyllite, tourmaline, emeryllite, epidote, zoisite, albite, asbestos, picrolite, adinolite, and tremolite.

Essence of Roman Chamomile.—E. Demarcq.—The author finds that this essence is a mixture of several ethers, among which the angelates and valerianates of butyl and amyl predominate.

Characteristics of the Polyatomic Alcohols, properly so-called.—M. Lorin.—The author considers that the property of producing oxamide may serve to recognise and define the chemical function of an alcohol, whatever may be its atomicity. The polyatomic alcohols, properly so-called, decompose above 100° common oxalic acid into water, carbonic acid, and formic acid. They combine successively with a part of the formic acid; and yield finally, on the one hand, a formine of the alcohol employed, and on the other, aqueous formic acid.

Variations in the Excretion of Urea under Normal Diet, and under the Influence of Tea and Coffee.—E.

Roux.—The author finds that in his case, at least, coffee and tea do not hinder the wear and tear of the tissues. Their effect seems, however, to diminish the longer they are used.

M. Vicaire's Physical Theory of the Sun.—M. Faye.—M. Vicaire's theory is, briefly, as follows:—The sun is a combustible mass burning (since a certain epoch) in an immense atmosphere of oxygen; which must extend beyond Mars' orbit, the tails of comets being produced by it. The central mass consists of metals chiefly, with hydrogen and carbon in combinations permitted by a comparatively low and constant temperature. It is liquid (at the surface at least), and gives off vapours which burn in the oxygen, producing the photospheric mass of flame with a temperature much higher than the interior. This temperature keeps constant in the same way as that of a candle flame. The products of combustion are partly gaseous (water, carbonic acid, &c.), partly solid (silica, earths, metallic oxides). The latter along with carbon, where oxygen is not in excess, produce the bright light of the photosphere. The oxidated matters floating at the surface of the photosphere unite in large scoriaceous masses, and fall into the interior liquid sea, producing the various phenomena of facule, spots, and protuberances. M. Vicaire supposes our earth—primarily formed of combustible matter, and surrounded with pure oxygen—to have taken fire and burnt some time. The arrest of the combustion would leave such products as we find. This hypothesis he transfers to the sun. In his criticism M. Faye, citing Laplace's hypothesis, thinks it impossible that in the period of cooling, the chemical actions should have been completely suspended; so that there should be this absolute separation between metals so readily oxidised (even in cold), and a vast reservoir of free oxygen. Further, the enormous extent of the oxygen atmosphere is a difficulty. Laplace held the sun's atmosphere could not reach the orbit of Mercury (as the outer layer could not extend beyond where centrifugal force balanced gravity). If the products of combustion become gaseous, and are diffused throughout an atmosphere more than 170,000,000 of leagues diameter, the sun ought to become a source of cold. If, on the other hand, the products are solid, the constant passage of oxygen towards the nucleus must generate heat; but then there must also be an angular acceleration of the envelope producing this, and not a retardation, as is supposed. There remain physical and mechanical difficulties connected with the presence of four planets, &c., within the huge atmosphere. The intensity and duration of solar radiation are against the hypothesis; the heat would not last with constant intensity longer than historic times. The candle comparison is not exact; for in the sun it is supposed that the solid products of combustion fall incessantly on the surface of supply, while the gaseous products progressively vitiate the atmosphere. A sun so constituted would soon be encrusted and extinguished, instead of lighting and heating our earth during immense periods. Then it is difficult to conceive how the pulverulent and light oxides, arising from combustion of calcium, magnesium, &c., agglomerate in those huge blocks; remaining suspended till they acquire sufficient density and volume to produce by their fall spots, facule, &c.; and how do such incandescent masses produce indifferently dark spots and bright facule? These scoriaceous, moreover, are not supposed to be thin pellicles, but enormous rigid masses capable of resisting for entire months the ebullition of the metallic ocean, and of intercepting the vapours which seek exit by their edges, and thus, M. Vicaire thinks, produce penumbra. M. Faye thinks the vertical section of a spot is entirely against this idea. He concludes with a *resumé* of eight different theories of the sun's constitution.

Determining the Wave Lengths in the Infra Red Part of the Spectrum by means of the Effects of Phosphorescence.—M. E. Becquerel.—M. Fizeau has shown that if a thin plate (mica, e.g.) be put before a slit

admitting solar rays from a heliostat into a dark room, there appear interference bands in the spectral image. Their number between certain limits is related to the wave lengths of the corresponding rays. They are very indistinct, however, the direct and twice-reflected rays having different intensities. M. Becquerel substitutes for the metallic plate of the heliostat a thin plate of mica on a plane non-reflecting surface. The rays reflected from the two surfaces of this plate have comparable intensities, and the bands are alternately bright and dark. One such plate, having a thickness less than $\frac{1}{10}$ of a millimetre, gave 113 fringes between the lines B and D of the solar spectrum. A somewhat thicker plate gave 35; but for phenomena of phosphorescence the number should be less, and the mica not more than $\frac{1}{10}$ m.m. thick. The phosphorescent substances, pulverised, are submitted to the spectrum thus crossed by interference bands. In the ultra violet the parts unequally active are distinctly shown; in the infra red they are less distinguishable, and very thin mica plates should here be used, as also a brightly phosphorescent substance like hexagonal blende. M. Becquerel finds wave lengths in some parts of the infra red exceed the double of the extreme red. But he does not yet furnish details.

Use of Armatures applied to Magnetic Bundles.—M. Jamin.—If several magnetised plates are superposed they react on each other, each destroying, in part, the magnetism of its neighbour; so that the portative force of the bundle is less than the sum of the forces of the plates considered separately. M. Jamin has found a means of preventing reaction and weakening for a time. He magnetises each plate separately; applies to it a well-fitting contact of the same thickness, which neutralises it; then superposes plates and contacts, fixing with screws the magnets together and the contacts together. This does not destroy the neutrality of the elements, but hinders their reaction. Thus to detach all the contacts a weight of 115 kilograms, was necessary, or a little above the sum (108) of the individual forces. Immediately the contacts are detached the plates cease to be neutralised; their magnetism reappears; they react on and weaken each other as before. Superposed plates with an armature are less charged (magnetically), and so react less on each other. Armatures weaken the magnetic intensity; their part is to offer a space where magnetism may collect and be preserved, which would otherwise be destroyed in consequence of mutual reaction between the constituents of the bundle.

Cubic Space and Volume of Air necessary to Ensure Healthiness in Inhabited Places.—Gen. Morin.—The author gives a formula indicating what amount of air should be renewed hourly for each individual, in order that carbonic acid and vapours exhaled may not accumulate beyond a proportion of 0.0005 in a given enclosed space. He finds that in a cubic space of 10 cubic metres this renewal hourly should be 90 cubic metres; in 12, 88; in 16, 84; in 20, 80; in 30, 70; in 40, 60; in 50, 60; in 60, 40. Various applications of the formula are suggested—barracks, bedrooms, public halls, hospitals, &c.

Direct Demonstration of the Fundamental Principles of Thermo-Dynamics.—Continued extract from memoir by M. Leduc.—The author here treats of the calorific energy and equilibrium of bodies; and gives a demonstration of the principle of mechanical equivalent of heat.

Memoir on Cerebral Localisations, and on the Functions of the Brain.—Dr. Fournié.

Maximum Resistance of Magnetic Coils.—Fourth note by M. du Moncel.—The author has shown in these notes—(1) That a given helix produces its maximum effect when its proper resistance is greater than that of the exterior circuit in the proportion of 1 to $1 + \frac{c}{a}$; (2) that with the same diameter of coil the helix giving the best results is that in which the wire has such thickness and

length that its resistance represents that of the exterior circuit; (3) that the thickness of magnetic helices should be equal to the diameter of the magnetic cores they surround; (4) that their length should be equal to this diameter multiplied by 11, or, practically, by 12.

Electrical Condensation.—Extract from memoir by M. Neyreneuf.—The air surrounding an electrified body experiences, like all insulating bodies, the effect of penetration in the nearest molecules, and of orientation in the more remote. The former act, in the production of a spark, not by direct transmission, but like the insulating plate of a condenser, i.e., by decomposition, by induction.

Uniformity of the Heart's Work when this Organ is not Subject to Exterior Nervous Influence.—M. Marey.—The author removes the heart of a tortoise, and adapts to it a system of fine caoutchouc tubes, representing arteries and veins. On contracting the artificial artery, and so increasing the resistance, the heart's movements are retarded; on lessening the resistance the beats are accelerated.

Effects Produced by Lightning at Troyes, on July 26, 1873.—M. Parent.—One interesting feature is the appearance of several balls of fire. One falling before a young woman rolled along the street, then disappeared; while hair pins, and other pieces of metal about her person, were violently torn out. Other incandescent bodies were afterwards found in a cooled state; one was like a piece of calcined stone, but was surprisingly light; some parts of it were dirty grey with black points, others reddish with bright reflection. The lightning produced some curious effects on a public building in the place.

Bulletin de la Société Chimique de Paris, tome xx., No. 3, August 5, 1873.

In the session of July 4 M. Prud'homme communicated some facts relating to rosolic acid. When phenol is heated with sublimed oxalic acid to 110° to 120° there is obtained a body which dissolves in water, and deposits in the form of a red powder. The solution dyes wool and silk like rosolic acid. The alkalis turn it to a rose colour. On heating to 180° we obtain rosolic acid, which precipitates in water as a green powder. The red powder and the rosolic acid yield with hydrosulphite of soda colourless compounds, soluble in water and alcohol. The combination which rosolic acid yields should be identical with that which Dale and Schorlemmer have obtained with the bisulphites. Schützenberger has shown the identity of the compounds formed by the hydrosulphite and the bisulphites with the hydride of benzol.

On Tereben.—M. J. Riban.—The author describes the preparation of tereben; its properties, its transformation into polymers, and into cymen, and the production of a camphoric matter.

Heat of Combustion of Formic Acid.—M. Berthelot.—This paper treats also of the heat of combustion of oxalic acid; of the heat developed by the reduction of permanganate of potassa, and of the oxidation of formic acid. It may be regarded as a continuation of the Berthelot-Thomsen controversy.

Researches on Chlorine and its Compounds.—M. Berthelot.—Another thermo-chemical controversial paper. The author examines the action of chlorine upon water, upon the mercurous and stannous chlorides, and ferrous sulphate.

Compound of Picric Acid and Anhydrous Acetic Acid.—D. Tommasi and H. David.—By the mutual reaction of these two bodies a compound is obtained of the formula—



which may be regarded as a picrate in which the atom of metal is replaced by acetyl.

Glycerin of the Aromatic Series.—Ed. Grimaux.—The substances examined are—dibromhydric stycerin; aceto-dibromhydric stycerin; tribromhydric stycerin; hydrochloric-dibromhydric stycerin; triacetic stycerin; and pheno-glycerin.

Process for the Quantitative Determination of Aniline Colours by Means of Hydrosulphite of Soda.—A. Stamm.—Up to the present time there has been but one process for determining the value of a colouring matter. It consists in dyeing or printing with the different samples, and comparing the intensity of the shades produced. This method answers perfectly for industrial purposes. But there exists no chemical procedure for determining these bodies, and proving their purity. The author considers that he has effected this object with simplicity and precision, by making use of the power which hydrosulphite of soda possesses of reducing and decolourising different tinctorial bodies, and, amongst others, those derived from aniline. The apparatus employed is essentially the same as that which Schützenberger and Risler employ for the determination of oxygen dissolved in water. The hydrosulphite is drawn up by aspiration into a Mohr's burette. The solution to be titrated is poured into a small flask closed with a caoutchouc stopper, pierced with three holes. Through one of these passes the delivery-tube of the burette, whilst the other two serve for admitting into the flask a current of carbonic acid gas, since the experiments must be made in the absence of atmospheric air. Lastly, as the decolouration of these matters only takes place at 100°—except in case of magenta which is decolourised in the cold—the flask is placed on a sand-bath, and the contents kept at the boiling-point. If it is required, e.g., to analyse a sample of magenta, we weigh out 1 or 2 decigrammes, which are dissolved in water and diluted to a litre. At the same time a solution is prepared of 1 or 2 decigrams of pure magenta in a litre of water. All that is required is to determine how many degrees of the hydrosulphite are required to decolourise each of these solutions. The ratio of the two numbers gives the value of the solution under examination. Other colouring matters have been titrated, and on comparing the results obtained it is found that 1 molecule of each of these different bodies whose composition is known requires for its decolouration the same quantity of hydrosulphite as would be consumed in reducing 2 molecules of ammoniacal sulphate of copper. This method offers another advantage—it enables us to judge of the quantity of colouring matter contained in an unknown liquid. It may be also used during the manufacture of aniline blues and violets to ascertain the amount of colouring matter which has been formed.

Compounds of Chloride of Titanium with the Ethers.—Eugène Demarcay.—The chloride of titanium is capable of combining with the oxygenated ethers, and with the alcoholic sulphides and hydrosulphites. With acetic ether it forms three compounds, as also with benzoic ether, with the butyrate, valerate, caproate, and angelate of ethyl, the valerate and acetate of amyl, and the benzoate of methyl. The ethers formed by bibasic acids furnish analogous compounds, but less stable. Oxalic and succinic ethers give two compounds. In constitution these compounds may be considered as chlorohydrines analogous to the silicic chlorohydrines of M. Friedel, united to the chlorides of acid radicals.

Manufacture of Gelatin.—M. F. Heuze.—The author's object is to obtain white gelatin from products of low quality. He attempted first to bleach the brown or nearly black gelatin, which is obtained as a secondary product in the manufacture of neat's-foot oil. This gelatin is applicable to very few uses on account of its dark colour, and is sold at 42 francs per 100 kilos. To prepare it, the feet—after removal of all parts useful for the turners—are digested in water or superheated steam at a pressure of 3 atmospheres. After three hours of digestion, and half-an-hour for settling, the strongly

ammoniacal solution of gelatin is concentrated; the supernatant oil having been previously removed. A dark brittle gelatin is thus obtained. The author tried to bleach it with sulphurous acid, or with a sulphate in presence of hydrochloric acid, but the results were unsatisfactory. He attempted then to modify the process of manufacture itself, diminishing the duration of the action of the superheated steam. Instead of drawing off all the liquor at the expiration of three hours, it was drawn off three times from hour to hour. The solution was then mixed with wood charcoal mixed with 25 per cent of animal charcoal, and after standing twelve hours was treated as above. The solution requires 4 per cent of the charcoal mixture. The product is a gelatin of good quality, which only presents a yellow tint when seen in large masses. It is tasteless and scentless, and is even fit for alimentary purposes.

Waterproof Glue.—Bichromate of potassa has the property of rendering insoluble, under the influence of light, certain organic bodies, such as gum, gelatin, glycerin, &c. If a paper covered with gum mixed with bichromate is exposed to light, the coating becomes quite insoluble even in boiling water. This property is utilised in the so-called "carbon" photographic process. Strong glue becomes insoluble more rapidly than gum, and the action takes place slowly even in the dark. A concentrated solution of bichromate is prepared which is kept in the dark, and a little of which is added to boiled gelatin. Objects glued with this, after some time can be washed either with cold or hot water.

Preparation of Parchment Paper.—M. J. Stinde.—The paper is prepared with the chromatised gelatin mentioned above. It serves in the preparation of the peasauges used in the German Army.

Improvements in Photo-Lithography.—M. Paul.—The paper is coated with a layer of white of egg beaten up and mixed with a concentrated solution of bichromate. When dry it leaves a hard smooth surface. After a sufficient insolation under the negative, the paper is covered with lithographic ink, then immersed in cold water to dissolve out the unchanged albumen, which is then removed with a fine sponge.

Bulletin de la Société Française de Photographie.
No. 7, 1873.

M. Despaquis presented to the Society proofs in Judea bitumen, mounted between two cards with an opening, and visible either by transmitted or reflected light. These proofs are stable, of a low price, fine in details, and have a pleasing sepia tone.

M. Briois, on behalf of M. de Sars, submitted to the Society a simple instrument, by means of which dried plates may be changed in full daylight.

Preparation of Albumen Plates by a Modification of Gaumé's Process.—M. Clouzard.—The author employs the following collodion:—

Ether	50 c.c.
Alcohol at 36°	50 c.c.
Soluble cotton	0.70 grm.

To prepare the albumen the author dissolves in 40 c.c. of water:—

Gum arabic in powder	2.5 grms.
Milk-sugar	1.0 "
Iodide of ammonium	3.0 "
Bromide of ammonium	1.0 "

This solution is added to 100 c.c. of albumen dissolved in acetic acid according to M. Alclaud's directions, and the whole is carefully filtered before use. The plates being prepared with the collodion and albumen, and well dried before being rendered sensitive, are submitted to the vapour of iodine for thirty seconds, when the temperature is from 18° to 20°.

Silver Bath.

Water	90 c.c.
Acetic acid	12 c.c.
Nitric acid	4 c.c.
Nitrate of silver	10 grms.
Iodide of ammonium	0.10 grm.

The precipitate of iodide of silver formed is left for some time in the solution, and stirred in order to saturate the liquid as much as possible. To render the plates sensitive they are immersed in this bath for a minute and a-half if the temperature is 18° to 20°.

Developing Bath.

Water	100 c.c.
Liquid ammonia	1 c.c.
Alcohol	2 c.c.

Water	100 c.c.
Bromide of potassium	0.25 grm.

1 volume of the second solution is mixed with 3 of the former; and this mixture is poured upon the plate previously moistened. The liquid is re-collected in a glass, and pyrogallol acid is added in the proportion of 5 grms. to 100 of the liquid employed. When the pyrogallol acid is dissolved the solution is again poured upon the plate, when the image appears in full detail if the exposure has been sufficient.

Application of Aniline in Photography.—M. Trouquoy.—This process has been previously noticed.

New Method of Removing Hyposulphite of Soda from Proofs on Paper.—M. Hermann Gunther.—The quantity of water needful for washing the proof may be diminished, and a better result obtained by using a solution of eau de javelle (hypochlorite of soda). In practice the proofs, after fixing, are washed in three successive baths of pure water. They are then passed into water containing a few c.c. of eau de javelle, and finally washed in pure water.

Suppression of Gold in Toning.—M. Bodgers.—The author prepares his silver bath at 6 per cent, and adds 10 drops of ammonia, and 10 of a saturated solution of alum per litre. On this bath the paper is floated three to five minutes according to the temperature. The impression is feeble than if chloride of gold had been employed. After exposure the proofs are washed for fifteen to twenty minutes, and then plunged in the following bath. Into 1 litre of water press the juice of five lemons, add 15 grms. acetate of soda, and 7.5 grms. of powdered alum, dissolve and filter. Pour 15 to 30 grms. of this solution into 2 to 4 litres of water; plunge the proofs into this bath, and let them remain five to ten minutes. Then submit them to the ordinary toning bath, substituting for the gold alum water in the proportion of 20 drops per litre of water. Let them remain two or three minutes only. Wash again, and fix with hyposulphite mixed also with alum (15 drops per litre of water).

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, Tome xxxi., No. 15, August 7, 1873.

Artificial Sugar.—The *Assemblée Nationale* promulgates a rumour that M. Jouglet has succeeded in forming sugar artificially, and at the low price of 5 francs per 100 kilos.

No. 16, August 14, 1873.

Prevention of Epidemics.—M. Chodzko.—The author declares that the phenols, the hypochlorites, and chlorine merely mask deleterious emanations without destroying them. He professes to have discovered a means of disinfection which neutralises all putrid effluvia. The process can be executed with rapidity, and costs only 10 centimes per cubic metre. (Unfortunately no indication is given as to the nature of this new disinfectant.)

Action of Iodine upon Caoutchouc.—M. Baumetz.—India-rubber tubes, whether vulcanised or not, if sub-

mitted to the action of iodine increase rapidly in bulk, and grow hard and brittle.

Double Phenomenon of Incandescence by Oxidation and Reduction.—M. Thomsen.—A cylinder is made of oxide of copper and gum-water. When dry it is reduced at a low temperature in a current of hydrogen. If while still hot this cylinder of reduced copper is placed in an atmosphere of oxygen it becomes immediately incandescent, and remains so till the oxidation is complete. If while still hot it is transferred to an atmosphere of hydrogen, a new incandescence takes place, due to the reductive action of the hydrogen.

Agricultural Value of the Human and Animal Excrement Annually Produced in France.—Taking into account merely nitrogen, phosphoric acid, and potash we find the following values:—

	Head.	Frs. c.	France.
Human	36,000,000	at 15/13 =	544,680,000
Oxen, &c.	10,000,000	at 18/94 =	1,819,400,000
Horses	2,000,000	at 132/74 =	398,200,000
Sheep	35,000,000	at 13/38 =	538,300,000
Swine	6,000,000	at 23/55 =	141,300,000
			3,441,900,000

The total amount of nitrogen contained in the excrements is 1,141,950,000 kilos.; which, at 40 kilos. per hectare annually, would manure all the cultivated lands in France, amounting to 27,476,000 hectares.

Polytechnisches Journal von Dr. E. M. Dingler, No. 5, 1873.

Investigations on the Solution of Gases in Cast-Iron, Steel, and Wrought-Iron.—L. Troost and P. Hautefeuille.

Recovery of the Gold which is Carried off along with Chloride of Silver during the Process of Refining with Chlorine.—Ad. Leibus.

Coal-Tar and Pitch.—E. A. Behrens.

Determination of Alcohol in Fusel Oil.—G. L. Ulex.

Respiration and the Internal Air of Beet-root.—A. Heintz.

A Fruitful Source of Ammoniacal Salts.—Bruno Terne.

Removal of the Refuse of Towns.

MISCELLANEOUS.

The Adulteration Act.—Mr. Wanklyn has been appointed Public Analyst to the County of Buckingham.

Photographer to the Shah.—We learn that Mr. A. J. Melhuish, F.R.A.S., has received the honour of special appointment as Photographer to His Imperial Highness the Shah of Persia, the reason assigned by the Shah for conferring this honour being that he had never had portraits which pleased him so much, although he had sent to artists at St. Petersburg, Berlin, and Paris.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the manufacture of artificial manure. Edward Charles Hamilton, Colchester, William Richard Preston, Harold Court, Romford, and Henry Jones, Colchester. January 16, 1873—No. 187. According to this provisional specification, sewage is mixed with or filtered through waste wool, wood dust, or shoddy; the materials are brought to a pulverulent form.

Improvements in the manufacture of gas. Miles Williams, Lion Oil-Works, Wigan. January 17, 1873—No. 205. This invention consists in forcing steam and oleaginous substances, more particularly hydrocarbon oils together, through an ordinary red-hot fireclay or iron retort filled or partially filled with coke, charcoal, or other similar substances. The gas so generated may be used, either alone or mixed with ordinary common coal or canal-gas generated in the usual manner; the result being a better and more economically produced gas.

An improved process of gilding on glass. Valentin Schwarzenbuch, Professor of Chemistry at the University of Berne, Switzerland. January 18, 1873.—No. 208. Take a solution of pure gold, that is to say, free from all other metals, effected by the ordinary chemical process. When pure gold is employed, the work is simple, since it is merely necessary to melt it in aqua regia or nitro-muriatic acid, and to evaporate it to the bain marie till it crystallises; in all other cases the operation is more complicated, on account of the manipulations necessary for separating the other metals, and it is generally requisite to precipitate the gold once by oxalic acid or by sulphate of iron, to bring it to the desired state of purity. After filtration, the solution of mass of perchlorate of gold should be brought to boiling-point with the water destined for its solution, as it invariably contains a considerable quantity of chloride of gold insoluble in water, which slowly decomposes in a cold state, very gently in percolation, or in metal cases which is instantly effected by ebullition. After filtration, the solution of gold is ready for use; its dephlegmation is regulated so that 200 c.c. contain 1 grain of metallic gold. This solution is then rendered alkaline by soda lye of mean strength, that is to say, a sufficient quantity is added to it to turn red litmus-paper blue; the addition of the soda should not cause any precipitate, and should never trouble the auriferous liquor; the quantity of soda must necessarily vary according to the dephlegmation of the solution. Before mixing the gold solution with the principal reagent destined to the reduction of the metal, it is indispensable to prepare the surface of the glass to be gilt with the greatest care, employing the same manipulations and materials used for cleaning photographic glasses; the reactive reductive is then prepared by saturating 30 per cent of spirits of wine with a current or mixture of marsh-gas or olefant-gas; this operation completed, the spirits of wine is freed with its volume of distilled water. The glass to be gilt is then disposed horizontally on another surface of glass, separated from it about the thickness of 1 mm., then 25 cc. of alcohol saturated with the gases is mixed with the auriferous solution; the liquid is then poured between the two glasses, and then left to stand for 2 or 3 hours, at the expiration of which time the gilding is completed. The upper gilt plate is then removed, carefully washed, and varnished.

Improvements in the manufacture of meat extract. Thomas Frederick Henley, St. George's Square, Pimlico. January 18, 1873.—No. 212. The object of this invention is so to treat meat for obtaining meat extract as to utilize all the elements of its composition instead of (as in the Liebig process) utilising only the soluble salts thereof.

NOTES AND QUERIES.

Pure Anthracen.—I should be glad if your readers would inform me of the best way of preparing crude commercial (say 30 per cent) anthracen, and also give me a good plan for the quantitative estimation of the same.—A. M. G.

"Charqui" and "Dampier."—"Permit me to call your attention as Editor to CHEMICAL NEWS, vol. xviii., p. 65. "Charqui, or dried beef, the damper of the Australian savages." This requires explanation, the word "dampier" in Australia being applied to a cake of flour and water.—E. DOLBY.

French Imperial Green and Persian Chrome Green.—I should feel greatly obliged if some of your readers would sketch briefly the cheapest commercial processes employed for the production of the following pigments:—(1). French imperial green, which appears to be a mixture of chrome yellow and Prussian blue, but which far surpasses in beauty all the ordinary chrome greens. (2). Persian red, sometimes called Chinese red.—This seems to be a dichromate of lead; but the original process of Liabig and Wöhler has, I believe, been superseded by much less expensive modes of manufacture. I have tried two processes mentioned in "Wagner's Technology" (English Edition, p. 66) viz., treatment of chrome yellow with caustic potassa solution, and Professor Dulong's process, but (perhaps through some fault of manipulation) I have failed to obtain a more brilliant colour than chrome orange.—I. HOWARD HUNTER.

British Association for the Advancement of SCIENCE.

22, Albemarle Street, London, W.

THE NEXT ANNUAL GENERAL MEETING will be held at BRADFORD, commencing on WEDNESDAY, September 17.

President Designate:

Professor A. W. WILLIAMSON, Ph.D., F.R.S., F.C.S.,

In the place of J. P. JOULE, D.C.L., LL.D., F.R.S., who has resigned the Presidency in consequence of ill health.

NOTICE TO CONTRIBUTORS OF MEMOIRS.—Authors are reminded that, under an arrangement dating from 1871, the acceptance of Memoirs, and the days on which they are to be read, are now, as far as possible, determined by Organising Committees for the several Sections before the beginning of the Meeting. It has therefore become necessary, in order to give an opportunity to the Committees of doing justice to the several communications, that each Author should prepare an Abstract of his Memoir, of a length suitable for insertion in the published Transactions of the Association, and that he should send it, together with the original Memoir, by book-post, on or before September 1, addressed thus:—The General Secretaries, British Association, 22, Albemarle Street, London, W. For Section.... If it should be inconvenient to the Author that his Paper should be read on any particular day, he is requested to send information thereof to the Secretaries in a separate note.

G. GRIFFITH, M.A., Assistant General Secretary, Harrow.

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THE CHEMICAL NEWS.

Vol. XXVIII. No. 719.

INVESTIGATION OF THE FLUORESCENT AND ABSORPTION SPECTRA OF THE URANIUM SALTS.*

By HENRY MORTON, Ph.D.,
and H. CARRINGTON BOLTON, Ph.D.

(Continued from p. 50).

PART II.

Absorption Spectra.

THERE are in the uranium salts two sorts of absorption—
one directly related to their fluorescence, and the
consequence of the fact that those rays which excite
fluorescence must themselves disappear, their motion
indeed simply taking that other form; and the other an
absorption having no such immediate relation to
fluorescence, but representing rays of the spectrum whose
motions are converted into heat or some other form of
force not sensible to the eye. This was observed by
Stokes in the case of canary glass, and in the solution of
the uranium nitrate (*Phil. Trans.*, 1852, pp. 497, 517).
The absorption-bands of the second variety were studied
by him in crystals of the nitrate of uranium in solutions
of the double carbonates of uranium, and in yellow and
green uranite (*Phil. Trans.*, 1852, p. 520).

Hagenbach† has also carefully measured both classes
of absorption in the case of canary glass and uranium
nitrate, and points out the distinction between the first,
which is correlative with absorption, and the last, which
is unaffected by solution, which almost destroys fluo-
rescence.

As regards absorptions of the first class they are best
studied by direct observation, combined with a process
closely allied to that described by Stokes as his *third*
method, which consists in throwing a pure spectrum upon
a screen of the substance in question, or upon the vertical
side of a tank containing a solution. With the solid
screen, the location of general maxima of fluorescence
will correspond with maxima of absorption, and with the
tank the absorption can be directly seen as embodied in

FIG. 3.



dark blades or triangular masses of shade running into
the tank (as seen from above) from the side away from
the light. These appearances will often indicate the
existence and relative intensity of absorptions, whose
exact location we can measure by examining the trans-
mitted light directly with the spectroscope in the manner
represented in Fig. 3.

The spectra of absorptions not directly related to
fluorescence is, as a rule, best studied by transmitted
light, although in the case of solids two other methods
give us accordant results.

First. When observing the fluorescent bands in the
usual way, if the spectroscope is directed a little obliquely
towards the bottle under examination (*i.e.*, a little to the
right or left of its centre), many of the absorption-bands
can be readily seen. This is especially the case with the
acetates, the oxalate, the calcium phosphate, and some
others.

Second. If a pure spectrum is thrown upon a screen
prepared with a coating of uranium salt, the absorption-
bands are very distinct, and their positions may be
measured as follows:—A pin-hole is made in the screen,
and this is moved laterally until the centre of a band falls
on the pin-hole. Then the refrangibility of the light
passing through this pin-hole is easily measured by a
spectroscope placed behind the screen, and gives the exact
location of the centre of the band.

As an example of the accuracy of this method I will
give the measurements of the absorption-bands of uranic
oxalate, as measured in the light transmitted by a layer
of the salt in powder attached by a little water to glass,
and as determined, by the method just described, on a
screen of the same substance.

Absorption-bands of uranic oxalate:—

By transmitted light ..	50° 43'	51° 07'	51° 33'	52° 00'
From a screen ..	50° 44'	51° 06'	51° 32'	52° 00'

The numbers here given are the direct readings on the
circle of the spectroscope.* The two observations were,
moreover, made at different times and by different observers,
one set being made by Mr. Sorge, one of the students of the
Stevens Institute of Technology. Many other measures
even more accordant were obtained, but the above was
selected as at once illustrating the ease and certainty of
the observations by these methods. The method of
measuring the bands by transmitted light has, however,
always been employed in the first instance, and the other
used only as a check and guide in doubtful cases.

The difference between different salts as regards their
absorption-bands is very great, as a glance at Fig. 1 will
show; and, while in many cases solution has a vast effect
upon fluorescence, it sometimes (as Hagenbach remarked
with the nitrate) produces but little effect upon the
absorption-bands. In other instances, however, very
marked changes occur, and, when these are followed out
to their legitimate conclusions, they lead us to some very
remarkable and not unimportant results. Thus, if we
examine the absorption spectra of the uranic acetate and
the various double acetates, we shall find that in the solid
state they present great variety in the exact location of
the bands, but in solution we have exactly the same
spectrum for all. The conclusion naturally, there-
fore, presents itself, that in solution all are reduced
to the same state, which could, of course, only be
by the breaking up of all the double salts. Indeed,
from this, supported as it is by other observations,
we do not hesitate to conclude that *no double acetate*
can exist in solution in water, but must break up
into its two single salts. Nor do our conclusions
stop here, but we must reserve others until some of
the facts on which they are founded have been de-
scribed. A similar experience leads us to a like con-
clusion in the case of the sulphates, oxychlorides, &c.

Attention was drawn to the fact of such displacement by
one of us in September of last year (*American Chemist*,
1872, p. 81), but its true bearing has only been perceived
recently, since a large number of observations have been
accumulated.

A change of character, rather than of position, produced
by solution in the absorption spectrum of didymium sul-
phate, was observed by Bunsen in 1866 (see *Pogg. Ann.*,
vol. cxviii., p. 100, and *Phil. Mag.*, 4th series, vol. xxxii.
p. 181).

The position of the band of uranium nitrate, while un-

* Communicated by President Morton.
† *Pogg. Ann.*, 1872, vol. cxlvi., p. 396.

* In this case 1° corresponds to 4-10ths of a millimetre of the Bunsen
scale.

affected by solution in water, is notably changed by other solvents, as the following table will show:—

Bands.	1.	2.	3.	4.	5.	6.
Glycerin	87.6	96.0	107.8	123.0	136.0	148.6
Water	89.8	98.5	108.5	118.7	129.5	142.0
Alcohol	—	99.4	111.7	—	—	—
Hydrochloric ether..	—	99.4	110.8	123.7	—	—
Ether	—	100.0	112.6	123.0	—	—
Acetic ether	—	101.0	111.7	128.0	135.4	—

These numbers are the averages of several sets of measurements, but the bands are in many cases very indistinct, and, in the case of the 4th band, much obscured by the Fraunhofer lines in the neighbourhood of G. The action of glycerin merits special notice, as compared with their positions in the solid; and in the aqueous solution all the bands below some point, about 110 of the scale, are depressed, while those above are elevated. Fig. 3 will make this evident at once.

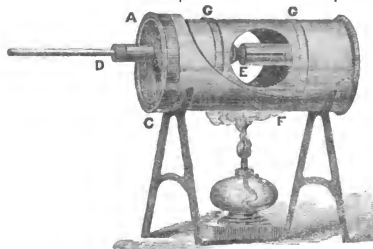
A change in position of the absorption and fluorescent bands of certain organic bodies, by change of solvent, was noticed by Hagenbach (see *Pogg. Ann.*, vol. cxlvi., p. 534), and he refers to researches by Kraus, published in the *Sitzungsber. der Phys. Med. Societät zu Erlangen*, July 10, 1871, in which that observer concludes that the denser the solvent the greater the downward displacement of the bands.

Effects of Heat.

It was observed by Stokes that canary glass and the nitrate of uranium had their fluorescence largely reduced by heating, and that at a temperature much below a red-heat their influence upon light in this respect was entirely suspended. He also noticed that in the solution of uranium nitrate the same effect followed from a moderate elevation of temperature, and near 212° F. had extinguished all fluorescence. In all cases the substance regained its fluorescent properties on cooling. He also remarked that no such action appeared in fluorescent vegetable solutions.*

Gladstone has made a series of investigations on the absorption spectra of solutions, among which is one in

FIG. 4.



which the effects of heat are considered. He finds that, as a rule, the effect of heat is equivalent to a concentration of the solution, and amounts to an increase in the amount of absorption.†

In a research "On the Change of Colour produced in Certain Chemical Compounds by Heat," Prof. E. J. Houston tested, among other things, a large number of solutions, and developed the curious fact—not before noticed—that in all cases where no chemical change was involved solutions as well as solids changed to tints lower in the spectrum by the application of heat.‡

* *Phil. Trans.*, 1852, p. 532.

† *Phil. Mag.*, 1857, vol. xi., p. 423.

‡ *Journal of the Franklin Institute*, 1871, vol. lxvii., p. 121.

The loss of fluorescence in a few substances when heated, which was noticed by Stokes, appears to extend (with certain limitations) to all the uranium compounds, both in their solid state and in solution.

We find that in the case of the anhydrous ammonio-uranic sulphate, fluorescence is sensibly diminished at 140° C., and is almost destroyed at 260° C. The hydrate does not show any marked loss of fluorescence below the point at which it begins to part with its water. The same is true of the potassium sulphate. The sodio-uranic acetate is, however, much more sensitive. Experiments were made with it and other salts in the following manner:—A small oven was made from a piece of brass tubing, about 5" long and 1.5" in diameter, closed with caps, one of which was provided with a tubular, c. Holes of 1" diameter were cut on opposite sides, and covered with thin plates of mica. The salt to be examined was then placed in a small specimen bottle, into which was passed the bulb of a thermometer, whose stem traversed the tubular, in which it was packed with soft asbestos. This apparatus was then substituted for the revolving stand, C, of Fig. 4, and the heating accomplished by a spirit-lamp, while the appearance of the bands was constantly observed.

Heat being thus applied to the sodio-uranic acetate, it was observed that at about 50° C. (122° F.) the brightness of the fluorescence was reduced, and that the uppermost decided band of fluorescence (81.8) lost its distinctness. As the temperature rose the amount of fluorescence gradually diminished, until, at about 110° C., it seemed to reach a minimum. It was also evident that the bands of fluorescence were displaced downwards in the spectrum by the increase in temperature, as will be fully shown by the following table of measures made at 19° C. (66.2° F.) and 116° C. (240.8° F.). At the higher temperature the uppermost band had entirely vanished, and the lower ones were too faint for measurement with the apparatus employed.

Fluorescent bands of sodio-uranic acetate:—

Bands.	1.	2.	3.	4.	5.	6.
At 19° C. (66.2° F.) ..	41.0	45.0	53.0	62.4	72.0	81.8
At 116° C. (240.8° F.) ..	—	—	53.0	61.0	70.8	—

No appreciable further change was produced by carrying the temperature to 150° C. (302° F.), and on cooling everything returned to its original condition. Solutions are still more sensitive in this respect. In the case of the sodio-uranic acetate, which gives a highly fluorescent solution, a very marked reduction can be perceived at 71° C. (160° F.), while at 82° C. (180° F.) there is hardly any trace of this fluorescent action left. So, again, with the ammonio-uranic sulphate in solution. Its fluorescence is first notably diminished at 71° C. (160° F.), and is almost inappreciable at 77° C. (170° F.), although it can still be seen at 88° C. (190° F.). In fact, every solution of a uranium salt which has any sensible fluorescence loses it in great part by a rise of temperature quite inside of its boiling-point.

With a number of these salts, moreover, we have noticed another curious effect, namely, a depression of some or all of their bands of absorption, as well as an increase and lowering in the general absorption which affects the upper end of their spectra.

The double carbonates furnish the most striking examples which we have yet observed, but the double sulphates show it very distinctly, as does also the oxalate.

The nitrate shows in solution a marked increase in general absorption when heated, but no displacement of bands that could be recognised. This also seems the case with the acetate and double acetates.

The table (Displacement of Absorption-Bands by Heat) will give some idea of the character of this displacement in several instances:—

DISPLACEMENT OF ABSORPTION BANDS BY HEAT.

Solution of ammonio-uranic carbonate in water:—

Bands.	1.	2.	3.	4.	5.	6.
Cold, 24° C. (75° F.)..	101.2	113.4	123.7	133.4	144.0	153.0
Hot, 86° C. (186.8° F.)	102.6	112.5	122.0	131.2	142.8	152.0

Solution of potassio-uranic carbonate in water:—

Bands.	1.	2.	3.	4.	5.	6.
Cold, 24° C. (75° F.)..	103.0	113.0	123.8	133.8	144.4	153.0
Hot, 86° C. (186.8° F.)	101.8	111.7	122.2	132.0	142.8	152.0

Solution of sodio-uranic carbonate in water:—

Bands.	1.	2.	3.	4.	5.	6.
Cold, 24° C. (75° F.)..	102.2	112.2	123.2	132.2	144.8	152.4
Hot, 86° C. (186.8° F.)	101.5	110.8	121.4	131.0	142.8	—

All these carbonates seem in solution to be without the band which is given in their solid condition at about 93.7.

Other salts also show a similar depression of absorption-bands by heat. Thus, in the uranic oxalate we have a displacement which, though small, is unquestionable, as the following table will show.

Solution of uranic oxalate in water containing oxalic acid:—

Bands.	1.	2.	3.	4.	5.	6.
Cold, 24° C. (75° F.)..	97.5	107.8	118.4	127.2	137.2	150.6
Hot, 86° C. (186.8° F.)	97.0	107.4	117.3	125.5	136.0	148.2

The double sulphates also exhibit a like action, as will be seen from the following tables.

Solution of potassio-uranic sulphate:—

Bands.	1.	2.	3.	4.	5.	6.	7.
Cold, 24° C. ..	88.5	96.0	106.4	115.4	124.4	136.5	150.0
Hot, 86° C. ..	94.5	104.6	113.8	123.0	133.0	—	—

Solution of sodio-uranic sulphate:—

Bands.	1.	2.	3.	4.	5.	6.	7.
Cold, 24° C. ..	87.0	96.0	105.8	115.8	125.7	136.8	149.0
Hot, 86° C. ..	—	95.0	105.0	113.8	123.7	135.0	147.0

Solution of ammonio-uranic sulphate in water:—

Bands.	1.	2.	3.	4.	5.	6.	7.
Cold, 24° C. ..	87.6	96.4	105.8	115.8	124.4	136.0	150.6
Hot, 86° C. ..	—	95.2	105.0	114.2	123.4	135.0	147.4

A similar displacement we have also observed in the five absorption-bands of potassium permanganate discovered by Stokes, as the following table will indicate.

Absorption-bands of potassium permanganate dissolved in water:—

Bands.	1.	2.	3.	4.	5.
Cold 24° C. (75° F.)..	54.7	63.3	72.0	80.6	88.9
Hot, 86° C. (186.8° F.)	53.8	62.4	70.8	79.8	88.0

No displacement could, on the other hand, be detected in the bands of uranic sulphate.

Passing now from these general considerations, we will discuss in detail the various classes of salts examined, beginning with their methods of preparation.

Purification of Material for the Preparation of Salts.

Much difficulty was experienced in procuring the raw material for forming the uranium salts even in a tolerable degree of purity. The uranic nitrate and uranic oxide (so called) found at dealers in rare chemicals always contain considerable quantities of soda, iron, calcium, magnesium, and various other impurities. Some of the pure oxide employed in this research was extracted directly from uranite itself, by a process previously described by one of us,* but this proceeding was abandoned on account of the great amount of time which it consumed.

The commercial uranic nitrate is generally the purest material, but it is the least advantageous, economically speaking, since it commands the same price as the so-called uranic oxide itself.

Uranic nitrate is readily purified by solution in strong

ether, the sodic nitrate and other impurities dissolving out in the water of the ether, and forming a layer below the ethereal solution. If the ether be allowed to evaporate spontaneously crystals of uranic nitrate are obtained, but we generally preferred converting this solution directly into uranic oxide, by gently heating until the ether is evaporated and the uranic nitrate is partially decomposed; a higher heat is then applied, and maintained until fumes of nitric tetroxide cease to appear.

Care must be taken to avoid too high a temperature, which would convert the yellow uranic oxide into the green uranoso-uranic oxide: in practice we found the desired temperature is obtained by using a Wetherill burner with the full amount of gas, or a Bunsen burner so placed that the flame cannot come in direct contact with the porcelain dish: in platinum vessels it is more difficult to prevent the formation of the green oxide.

The caked mass of uranic oxide is then removed from the porcelain dish, finely pulverised in an agate mortar (no light task), and again heated until the last traces of nitric tetroxide are removed.

The commercial uranic oxide is invariably either ammonio or sodic uranate, containing also various impurities. The manufacturers of chemicals, who prepare uranium compounds for the trade, are apparently ignorant of the fact that uranic oxide precipitated from its solutions combines with whatever alkali is employed, forming a uranate of the base, or else they knowingly dispose of these uranates as uranic oxide, for reasons satisfactory to themselves. Uranium yellow, so-called, employed by glass and porcelain manufacturers, is prepared directly from the mineral uranite, and consists of sodic uranate; possibly this gets into market as pure uranic oxide.

The pure material which forms the point of departure for the preparation of the salts named in this paper is obtained from the commercial article by the following process:—The impure alkali-uranate is dissolved in hydrochloric acid, the solution is saturated with sulphydric acid, which nearly always produces a small precipitate, filtered, boiled, oxidised with nitric acid, and then poured into a quantity of very dilute ammoniac hydrate, more than sufficient to neutralise all the acid: by this means the sodic uranate is for the most part converted into ammonio uranate. The precipitate is well washed by decantation (using a syphon) adding a little ammoniac chloride to the wash-water when the precipitate refuses to settle, and then transferred, without bringing on a filter, to a porcelain dish. Ammonio carbonate is then added in powder to avoid largely diluting the solution formed, and the whole is digested at a moderate heat until the ammonio uranate is completely dissolved. The solution, filtered while warm from the residue of ferric hydrate, calcium carbonate, &c., deposits, on cooling, beautiful crystals of the double ammonio-uranic carbonate. The mother-liquid from these crystals is vigorously boiled, and deposits a yellow powder, uranic hydrate containing a small percentage of ammonia. This precipitate, however, still retains the alkaline earths and sodium, and the crystals, before obtained, show traces of sodium uranate: these impurities are removed by igniting strongly in a platinum dish, and treating the uranoso-uranic oxide formed with dilute hydrochloric acid, which dissolves out the uranates of the bases RO, while the uranoso-uranic oxide is not attacked. After washing and drying this green oxide, it is dissolved in nitric acid and the solution crystallised; the crystals of uranic nitrate are then dissolved in ether, and treated as above described.

In preparing the various compounds enumerated in the first part of this paper, we generally followed the methods laid down by the authors in their original papers; any detailed account of these methods is therefore superfluous. References to the original papers will be found in the "Index to the Literature of Uranium," prepared by one of us and published in the "Annals of the Lyceum of Natural History (New York), vol. ix., 1870.

A brief summary of some points in the preparation of

* American Chemist, vol. i., p. 50, 1870.

the salts will, however, be given in connection with the special discussion of each class.

(To be continued.)

ERRATA.—Page 47, first column, line 27 from foot, insert "and" between "of" and "while." Second column, line 34 from foot, for "combination" substitute "confirmation." Second column, line 12 from foot, insert "were" between "concentration" and "interchangeably." Second column, line 2 from foot, for "Deraga" substitute "Desaga."

THE CONSTITUTION OF SAFFRANIN.

By SAMUEL E. PHILLIPS.

In such cases the men of fact and experiment are as yet dependent on speculation, it is surely legitimate to assist such endeavours by all the means at our disposal, the more so if, by placing the matter in another aspect, we can at all add to their powers of practical enquiry, on the old Baconian principle that the secrets of Nature are most freely given up to such as can enquire with humility and intelligence.

We have long regarded the rosanilin dyes as associated with the guanidin type—

Urea $(\text{CO}_2) \text{H} \text{H}_3\text{N}_2$
Guanidin .. $\text{H}_2 \text{Cy} \text{H}_3\text{N}_2$
Melanilin .. $(\text{C}_{12}\text{H}_5)_2\text{Cy} \text{H}_3\text{N}_2$
Rosanilin .. $(\text{C}_{38}\text{H}_{16})\text{Cy} \text{H}_3\text{N}_2$; $\text{C}_{38}\text{H}_{16} = 2$ atoms.

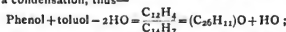
Chrysanilin .. $(\text{C}_{38}\text{H}_{14})\text{Cy} \text{H}_3\text{N}_2$

Anilin blue .. $(\text{C}_{35}\text{H}_{10})\text{Cy} \text{E}_3\text{N}_2$

Leucanilin .. $(\text{C}_{38}\text{H}_{18})\text{Cy} \text{H}_3\text{N}_2$

Opal blue .. $(\text{C}_{38}\text{H}_{15})\text{CyPhH}_2\text{N}_2$

Both practical and theoretical considerations strongly enforce the idea of a condensation of atoms herein. If, instead of anilin and toluidin, the same conditions were applied to phenol and toluol, the result would certainly be a condensation, thus—



but, as variations take place by addition or subtraction of 2H, I have preferred to consider the whole group as equivalent to 2 atoms, however arranged or modified.

Chrysanilin, with 3Me replacing 3H, gives a beautiful deep-orange-yellow as the iodhydrate, and rosanilin varieties have been formed, with similar aldehyd substitutions, with the radicals of almond oil ($\text{C}_{14}\text{H}_{13}$), enanthol ($\text{C}_{14}\text{H}_{13}$), valerol (C_{10}H_9), &c.

Melanilin is produced by the action of cyanogen upon anilin, and when rosanilin is heated with "cyanogen, it loses colour, and deposits a new base with 4N which is regarded as leucanilin in which 1H is replaced by Cy." This is called hydro-cyan rosanilin, and this we now moot as the type of saffranin and mauvin.

The production of saffranin from azo-diamines is another illustration of the condensing conditions we have referred to—

Hydro-cyan rosanilin .. $(\text{C}_{38}\text{H}_{18})\text{Cy}_2 \text{H}_2\text{N}_2$

Saffranin $(\text{C}_{38}\text{H}_{18})\text{Cy}_2 \text{H}_2\text{N}_2$

Mauvin $(\text{C}_{38}\text{H}_{18})\text{Cy}_2\text{PhH} \text{N}_2$

Are these (3 atoms in 2) varied in this case isomerically, or is the beautiful orange-yellow cyan-rosanilin iodhydrate identical (in its base) with the deep red-yellow saffranin chlorhydrate?

The cyano-production of all these bodies is feasible beyond measure synthetically; and may we look for some new efforts to realise this point analytically?

Whatever be the result, one thing is quite clear, viz., that all these bodies are defiant of the Hofmann law of ammonia combinations. Whether diamines as I view them, triamines, or tetramines, they obey a simpler wider law, and combine with acids, atom for atom—

The free base .. $(\text{C}_{38}\text{H}_{18})\text{Cy}_2\text{H}_2\text{N}_2$

Chlorhydrate .. $(\text{C}_{38}\text{H}_{18})\text{Cy}_2\text{H}_2\text{N}_2.\text{Cl} + \text{HCl}$

Chloroplatinate .. $(\text{C}_{38}\text{H}_{18})\text{Cy}_2\text{H}_2\text{N}_2.\text{Cl} + \text{PtCl}_4$

Nitrate $(\text{C}_{38}\text{H}_{18})\text{Cy}_2\text{H}_2\text{N}_2.\text{O} + \text{NO}_3$

Hofmann further refers to the sulphate, oxalate, &c., all of which doubtless similarly conform.

Magdala is another red dye which may possibly belong to the same character of type, constitution, and general properties. Some years ago, Perkin and Church obtained "a beautiful crystalline compound, consisting of 2 atoms of naphthylamin linked together by an atom of trivalent N—



and subsequently M. Clavel, of Basle, patented a process for a beautiful crimson dye "heating together equal quantities of isomeric naphthylamin, acetic acid, and nitrite of potassium." This can now be obtained from ordinary naphthylamin and "an acid, by a process similar to that of rosanilin from anilin, and we thus get magdala—



and, in boiling the first with anilin, we evidently get—



another red colouring matter."

Rosanilin $(\text{C}_{26}\text{H}_{11})(\text{C}_{12}\text{H}_5)\text{CyH}_2\text{N}_2$

Perkin and Church .. $(\text{C}_{20}\text{H}_7)(\text{C}_{18}\text{H}_9)\text{CyH}_2\text{N}_2$

Magdala $(\text{C}_{40}\text{H}_{13})(\text{C}_{18}\text{H}_9)\text{CyH}_2\text{N}_2$

Red colouring matter .. $(\text{C}_{40}\text{H}_{13})(\text{C}_{18}\text{H}_9)\text{CyH}_2\text{N}_2$

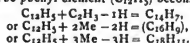
In the last two I have, for reasons before mentioned, assumed the naphthyl element as a dinaphthyl, which is not a mere hypothetical body; but, if preferred, it may be regarded as $(\text{C}_{20}\text{H}_7)_2(\text{C}_{18}\text{H}_9)\text{CyH}_2\text{N}_2$. Against this latter view I would urge that, as we have an ethyl-mauvin, so we might have ethyl, methyl, or aldehyd replacements of both saffranin and magdala, and these might show whether we have 2 or 3 atoms of H available for these replacements.

Having felt some interest in writing this short notice offhand, I laid it down with a strong feeling of dissatisfaction, in that it fell so far short of what seemed to be desiderated in regard to the condensing conditions implied in the multifarious production of azodiamine, nitrile, and other bases. The refined labours of Griess, Hofmann, and others, have produced a very wide harvest of facts, and some great effort is needed in the direction of a simple and comprehensive classification.

This new and fertile character of reaction comes in contact at several points with anilin, or rather coal-tar, production; at another moment we are penetrating the indigo or kreatinin series; while, at another point, we are immersed in caffeine or uramin derivatives; and it is almost beyond question that, in the whole of these, a certain amount of carbon is condensed into the cyanogen atom. But the cyano aspect is only one feature of the reaction, and the other, most relied upon in our estimate of saffranin, meets with a striking confirmation in another memoir from that fertile pen which has laid us under such deep obligation. We may cavil at certain points of hypothesis or type-representation; but for a commanding genius, for one who penetrates so successfully into unknown regions, there can be only one award of universal

esteem and admiration. We therefore continue the subject by a brief abstract of M. Hofmann's paper (CHEMICAL NEWS, vol. xxvii., p. 1). "On the Synthesis of Aromatic Ammonias by Atomic Interchange." He found that the action of methyl alcohol on aniline, at high temperature and pressure, is far from producing methyl- and dimethyl-aniline exclusively, as hitherto believed, and that the substitution takes place in the phenyl radical, thus producing quite a series of higher homologues. He thinks the replacement of the Me takes place first in the fourth atom of H in the chlorhydric acid of the aniline salt," then in the others, and finally in the phenyl radical itself, but moots it as strange that, when a tertiary monamine is submitted to the action of an alcoholic chloride, a quaternary ammonium is invariably found; and yet, in the above process, only tertiary, and never any quaternary, bases are observed.

In the praiseworthy "endeavour to gain an insight into the mechanism of this reaction," M. Hofmann assumes what is perhaps unnecessary, and strangely overlooks the patent facts of the condensing conditions, and the evolution of H in the substitutional condensation of the phenyl radical. The phenyl element (C_6H_5) becomes—



Ordinary action $(C_{12}H_5)Me_2N + MeCl =$
 $(C_{12}H_5)Me_2N, Cl$
 Do. with heat and pressure .. $(C_{12}H_5)Me_2N + MeCl =$
 $(C_{14}H_7)Me_2HN, Cl$

His illustration of the real facts of the case is plain beyond measure:—"Accordingly, trimethylated ammonium iodide, submitted to the action of heat and pressure, is transformed into—

- (1) Dimethyl-toluidin iodhydrate.. $(C_{14}H_7)Me_2H, N, I$
- (2) Methyl-xylidin iodhydrate .. $(C_{16}H_9)Me, H_2N, I$
- (3) Cumidin iodhydrate $(C_{18}H_{11})H_3N, I$

Here, then, is one of the first formal demonstrations of the action we have mooted as the secret or chief feature in the production of rosanilin or safranin varieties, and guided by a parallel study of the same influence, we confidently predict the imminent artificial production of their or caffeine, of which more anon.

CARBOLIC ACID AND ITS RELATION TO CREASOTE.* By A. M. READ.

CARBOLIC acid was discovered in the year 1834, by Runge, who found it to be a constituent of coal-tar oil. Its chemical properties were more thoroughly investigated in the year 1841, by Laurent, who made it from the lighter oils of coal-tar, and who considered it to be an hydrated oxide of a peculiar compound radical, which he called phenyl, and described it under the name of hydrate of phenyl. It has been variously named by different writers, phenic acid, phenyl alcohol, hydrate of phenyl, coal-tar creasote, carbolic acid, and phenol, the latter of which is the name under which it is generally treated of in textbooks, although carbolic acid is and probably ever will be its common name.

Carbolic acid is produced by the action of nitrous acid on aniline, and by the dry distillation of gum benzoïn, quinic acid, chromate of pelosina, salicylic acid, coal, and the resin of *Zanthorrhæa hastilis*. It is found in the urine of the horse, cow, and man, and in castor. It is also reported as having been obtained from a plant growing on the high lands of India (the *Andromeda Leschenaultii*), which is said to yield a very pure quality, less deliquescent

than that made from coal-tar oil, but at a much greater cost. It forms the chief constituent of the acid portion of coal-tar oil, from which it is generally obtained by the process given below.

The coal-tar oil is subject to distillation in a retort furnished with a thermometer, and the portion that passes over between the temperature of 150° and 200° C. (302° and 390° F.), is collected apart. This product is then mixed with a hot strong solution of caustic potash and left to stand, whereby a whitish, somewhat crystalline pasty mass is obtained, which, by the action of water, is resolved into a light oily liquid and a dense alkaline solution. The latter is withdrawn by a syphon, decomposed by hydrochloric acid, and the separated oil purified by contact with calcium chloride, and re-distillation. It is then exposed to a low temperature, and the crystals formed are drained from the mother-liquor and carefully preserved from the air.

Pure carbolic acid forms long colourless prismatic crystals, which melt at 35° C. (95° F.), to an oily liquid, boiling at 180° C. (356° F.), and greatly resembling creasote in many particulars. It is soluble in about 14 parts of water, freely soluble in alcohol, glycerin, ether, and strong acetic acid, and gives no acid reaction to test-paper. It is very deliquescent, absorbing moisture from the atmosphere with avidity and liquefying. It coagulates albumen readily, and is therefore a powerful antiseptic. Sulphur and iodine dissolve in it. Nitric acid, bromine, and chlorine attack it with energy, forming substitution products, all of which are of an acid character. It also forms substitution products with sulphuric acid, and is dissolved by alkalis, forming salts called phenates. It reduces mercuric oxide at the boiling point; separates silver from the nitrate; reduces the peroxide of lead to the protoxide; and upon heating it with arsenic acid forms a yellow substance called xanthophenic acid. One of the most common impurities found in carbolic acid is coal-tar oil. This can easily be detected by mixing the suspected acid with about 20 parts of water, when the acid will be dissolved, leaving the insoluble oil floating on the surface. Pure carbolic acid gives a pure blue colour to pine wood previously treated with hydrochloric acid; a green colour indicates aniline, and a brown pyrrhol. It ought not to turn brown in the air, even in the presence of ammonia; and should give, with sulphate of iron, not a red but a pure lilac colour. When immersed in an aqueous solution of chromic acid it is immediately turned black.

There have been a great many tests given to distinguish creasote from carbolic acid; but none of them have proved satisfactory. I give below some of the principal ones now used for that purpose.

With three or four volumes of a saturated aqueous solution of baryta, carbolic acid forms a clear solution, which, after standing, gives no deposit, or only a slight pulverulent one, while with creasote it forms an incomplete cloudy solution.

With an alcoholic solution of chloride of iron, creasote gives a green colour, carbolic acid a brown; but with an aqueous solution of the same, creasote gives no reaction, while carbolic acid gives a blue colour.

According to Mr. Morson, pure creasote is insoluble in glycerin, while carbolic acid forms with it a perfectly clear solution. As this test has been the subject of some controversy which has attracted considerable attention, I have made a few experiments with it, the results of which I give below.

I first tried the common creasote of commerce with an equal volume of glycerin, and found it to be readily soluble; Merck's gave the same result, but Morson's refused to dissolve in glycerin, sp. gr. 1.253, even after three or four volumes had been added.

I then carefully added carbolic acid to a mixture of Morson's creasote and glycerin, and found that upon the addition of 23 per cent of Calvert's No. 2 acid the creasot

* Read before the National College of Pharmacy, Washington, D.C.
 † From its volatile oil, of the composition of oleum gaultheriæ.—*Ed. Am. Journ. Pharm.*

became soluble, forming a perfectly clear solution with the glycerin.

Upon the addition of water to the three solutions of creasote, they each became cloudy, and the creasote soon separated; while upon a solution of carbolic acid in glycerin, water had no effect whatever.

Some time ago, while preparing a catarrh mixture in which carbolic acid is used in conjunction with liquor ammoniac fortior, alcohol, and water, I found that upon the addition of the ammonia to the acid, the acid was readily dissolved, forming a clear solution, which did not change upon the addition of the other ingredients; but which, after standing a few hours, became a beautiful violet blue colour. Having been taught by text-books that carbolic acid was insoluble in ammonia, I was somewhat surprised at this result, and upon referring to Watts, Gmelin, and other authorities, and finding that they made the same statement,* my surprise was somewhat intensified. I immediately instituted a series of experiments, and found that carbolic acid was certainly soluble in ammonia, but whether owing to impurities present I could not say. I used Calvert's No. 2 acid, which was immediately dissolved by the ammonia, forming a clear solution, which, upon standing about six hours, gave the violet blue colour spoken of above, the acid still remaining in solution, and giving no precipitate.

I then tried the ammonia upon common creasote, which I found to be insoluble in it, but which, after a short time, acquired a light blue colour.

To carry these experiments to a successful issue, it became necessary to procure chemically pure carbolic acid and creasote. After a number of attempts I succeeded in getting Morson's and Merck's creasote, and having in the meantime found in the *Druggists' Circular* a process for purifying carbolic acid, which, with some modifications, I have used, I have succeeded, I think, in confirming my first experiments.

I will give the process of purification as used by myself. I put into a pint flask 1 oz. of Calvert's No. 1 acid, crystallised, and gradually added to ozs. of distilled water, shaking it frequently, when I found that 64 drachms of the acid were dissolved, leaving 11 drachms undissolved to contain the impurities, which are less soluble than the acid. As soon as the solution became clear I carefully poured it off, placed it in a hydrometer glass, and added, with constant agitation, finely powdered salt (previously purified by dissolving it in water, filtering the solution, and evaporating to dryness), until the water was saturated, and the acid arose to the top. I then carefully removed the acid with a pipette. Upon the addition of ammonia to this product it was very readily dissolved; but it did not give the violet-blue colour until after standing about twelve hours. Not being satisfied, I re-purified it in the same way, being careful not to add as much water as I did at first.

The addition of an equal volume of ammonia to this product of re-purification quickly dissolved it, forming a perfectly clear solution, which did not acquire the violet-blue colour until standing nearly thirty hours.

For want of time I was not able to carry the purification by fractional distillation as I should like to have done; still I consider the product of re-purification very nearly

* Note by the Editor of *Am. Jour. Pharm.*—Gmelin's "Hand-book," edition of Cavendish Society, vol. 25, p. 150, contains the following:—

Carbolsol of Ammonia.—Carbolic acid absorbs ammoniacal gas abundantly and with evolution of heat, forming carbolsol of ammonia (Laurent, *Ann. Pharm.*, 47, 75). This salt, raised in the state of vapour through a glass tube at a low red heat, deposits a small quantity of charcoal, but does not form any aniline; which, however, is formed at 300° C. in sealed tubes, and sparingly when an alcoholic solution of carbolsol of ammonia is set aside for a month (Laurent). Strong ammonia dissolves quickly in cool creasote, and the mixture turns red when exposed to the air (Reichenbach). The salt obtained with carbolic acid remains colourless, and even when it contains but little ammonia, exhibits alkaline reaction, exhales ammonia, and volatilises (Runge). Creasote dissolves in ammonia, even in the cold; and the solution gives off all its ammonia at 300° (Görup-Besang).

pure—much purer, at least, than any I could find in the market.

Upon the addition of ammonia to this acid, as stated above, it was readily dissolved; while, upon Morson's creasote, ammonia had no effect whatever, neither dissolving it nor giving it the blue colour that it gave to the common creasote. Merck's creasote gave the same result; it as well as other samples that I have tried being perfectly insoluble in ammonia.

The ammonia used in the experiments given above was the aqua ammoniac fortior of the U. S. P., sp. gr. 0.900. The aqua ammoniac U. S. P., sp. gr. 0.960, would answer the same purpose, but a much larger proportion would be required.

After the successful termination of the experiments given above, I have no hesitation in suggesting aqua ammoniac fortior as a test to distinguish between carbolic acid and creasote; and of leaving its value as compared to other tests now known to the judgment of the pharmacist and chemist.

IRON ELECTROTYPES.

THE art of electrotyping, already applied to myriad uses, shows constant evidence of progress, especially in the successful deposition for practical purposes of metals that have hitherto been considered intradable. Nickel plating is now common, and, while cheaper, is for some purposes superior to silver; and there is some reason to suppose that by the employment of a small percentage of some other metal to diminish the brittleness, the rather refractory nature of the nickel coating may be brought more completely under the control of the bunnisher in lieu of the polishing wheel, than is now the case. There are many purposes, however, for which a plating of iron would be, all things considered, better than any of those now familiar in electro-metallurgy, and to secure this has occupied the attention of some foreign experimenters, who have apparently been very successful in their efforts. These are described in a lengthy article in a number of *Engineering*, from which we take the following:—

"At the late London International Exhibition (1871) were exhibited bank-note plates, medallions, and a page of printing-type, electrotyped in iron by a process devised by M. Eugene Klein, who is at the head of the Chemical Department in the Imperial State Paper Manufactory in St. Petersburg. From a paper upon the subject, read by Professor Jacobi before the Academy of Sciences in Russia, in 1868, it appears that in the previous year M. Feuguères sent to the Paris Exhibition some specimens of iron electrotype which presented a fair appearance as regarded surface, but still were inferior to those produced by M. Klein in the year following. M. Klein saw M. Feuguères's specimens at the Paris Exhibition, and on his return to St. Petersburg, in October, 1867, renewed his previous attempts to electrotype in iron. The scientific interest which attached to the new development, and the eminently useful applications of which he saw it was susceptible, especially in the departments of engraving and printing, stimulated M. Klein, and in the early part of 1868 he had accomplished his object. The medals produced in the early part of M. Klein's researches showed on their reverse porosity and deep hollows, which penetrated nearly through the thickness of the deposit. These cavities were also observable in great numbers in the productions of M. Feuguères. In M. Klein's later specimens these singular cavities—which probably proceeded from bubbles of gas—entirely disappeared, and their reverses are in no way inferior to those of copper specimens produced under the best conditions. The starting-point of M. Klein was the coating of engraved copper-plates, which process was effected in a bath composed of the chlorate of ammonia and iron, to which he added a small

portion of glycerin. Those, however, who have paid attention to the steeling process have had occasion to remark that in giving the deposit of iron a greater thickness, the surface cracked, and the deposit detached itself from the cathode in excessively brittle flakes. It became necessary, therefore, to employ baths of two different classes, composed of sulphate of iron and sulphate or chlorate of ammonia. Finally, M. Klein devised three baths after the formulae $\text{FeO}, \text{SO}_3 + \text{NH}_4\text{O}, \text{SO}_3 + 6\text{H}_2\text{O}$.

The first bath consists of a concentrated solution of crystals of the double salt $\text{FeO}, \text{SO}_3 + \text{NH}_4\text{O}, \text{SO}_3 + 6\text{H}_2\text{O}$ above mentioned. The second bath was composed by mixing the concentrated solution of each of these two salts in the proportions of their equivalents. At length M. Klein obtained the third bath by taking a solution of sulphate of iron, precipitating the iron by carbonate of ammonia, and dissolving the precipitate by sulphuric acid, getting rid of all excess of acid. In preparing the baths of the second class, M. Klein, as we have stated, mixed the solutions of chlorate of ammonia and sulphate of iron in the proportions of their equivalents. Another method employed is to dissolve, in a solution of sulphate of iron, as much chlorate of ammonia as it will readily absorb at a temperature of about 66°F . All these baths were concentrated as highly as they could be. As an anode, M. Klein employed iron plates giving a surface of about eighty times that of the copper cathode. In using a Daniell battery for the decomposition, the deposit was formed in twenty-four hours upon the whole of the cathode. The deposit, however, was full of flaws, and was easily detached and broken up into fragments. As it often happens that the solution of sulphate of copper improves by use, M. Klein hoped that the iron solutions would act in a similar manner. He therefore continued the experiments for several days, without, however, obtaining any better results. Under the advice of Professor Jacobi, instead of a pair of Daniell cells for each of the five stages of decomposition, he then employed four pairs of feeble Meidinger cells, uniting them in series with the five stages of decomposition. This arrangement was found to give a smaller development of hydrogen at the cathodes, and a better final result. The deposits, however, were not yet perfect, some exhibiting porosity, and others being furrowed.

Conceiving from previous experience that this was due to acidification of the bath, M. Klein tested it, and found a very decided acid reaction. He attributed this acidification to the circumstance that the quantity of iron deposited on the cathode was greater than that dissolved by the anode. It was, therefore, necessary to give the anode a greater degree of solubility, and as that could only be effected by increasing its area, M. Klein conceived the idea of placing in the bath a plate of copper, and uniting it with the iron. The result of this combination was very remarkable; not only were the baths of the first class rendered neutral after several hours, but the deposits became much more uniform. Their colour was a dull grey; they adhered perfectly to the cathode without warping or cracking any part. During the first twenty-four hours the surfaces remained perfectly even, but afterwards they began to exhibit minute cavities similar to the appearances often produced upon galvanic deposits of copper. These cavities, however, rarely penetrate to the depth of the deposit. Their production is attributed to the superabundant disengagement of gas on the surface of the cathode. It probably happens that these bubbles attach themselves strongly enough to hinder the formation of the deposit. If the energy of the current becomes too great, these annoying phenomena are produced more frequently. By reducing this energy in the process, and having only an imperceptible disengagement of gas, by diminishing the concentration of the bath, or augmenting the resistance of the solid portions of the circuit, the formation of these cavities entirely disappeared, and the beautiful results to which we have already referred have been obtained. A microscopic examination of the reverses of the deposits produced by M. Klein's final process

fails to discover any porosity or irregularity in the specimens. On leaving the bath, the iron is as hard as tempered steel, and very brittle. Re-heated to a dull red heat, it loses much of its sharpness and hardness. Heated to a cherry-red, it becomes malleable, and may be engraved as easily as soft steel. If the deposits are produced in good condition, and annealed uniformly and with the necessary precautions, they are subject to neither warp nor bend. There is no contraction, but, on the contrary, a slight degree of expansion, almost imperceptible, however. Owing to the necessity of having bank-note and similar plates identical in every respect, it is of the first importance that they should not be distorted, nor have their dimensions altered in the process of annealing. It appears that the galvanic deposit of iron has not only permanent magnetism, but that, like soft iron, it receives the magnetism of position. Of the importance of the practical application of the process there can be no doubt whatever. By replacing plates of copper by those of iron, greater facilities will be afforded for producing publications, works of art, and especially bank-notes and cheques. Iron electrotype plates are found to be almost indestructible. They not only can be printed from an almost unlimited number of times, but they are better calculated than those of copper, to withstand those inevitable accidents constantly occurring in printing establishments. Printers are sometimes obliged to set aside as useless their best plates, which are often damaged by a grain of sand or by a chance knot in the paper. These accidents not only involve the expense of renewing the plates, but sometimes occasion interruptions and delays in works of a very pressing nature. These are some amongst the many advantages which may be expected to accrue from the introduction of iron electrotypes."

ON THE ENERGIES OF THE IMPONDERABLES, WITH ESPECIAL REFERENCE TO THE MEASUREMENT AND UTILISATION OF THEM.*

By the Rev. ARTHUR RIGG, M.A.

(Continued from page 106.)

Now, to examine these muscles—their fibres and their fibrillæ, to watch their action, and to speculate upon the causes of this action, is a department of science full of interest, and from which much that is valuable may be brought. The object of this lecture does not require that any such investigation should be made, and the competency of the lecturer is not equal to the task. Dr. Haughton, of Trinity College, Dublin, has for many years sought for means and opportunities, and availed himself of them, even at the risk of his own life, for determining accurate measurements of muscular force. This first mention of the name of one who for twelve or fourteen years has given that attention to this subject which enthusiasm alone could induce, must not be passed without this addition. In reply to a letter towards the close of 1872, Dr. Haughton most kindly sent me 400 pages of the proof sheets of a work on "Animal Mechanics," which has not yet been published.† This work is my authority for the figures relating to the experiments in respect to muscular strength and endurance. With the results his careful and numerous opportunities have afforded him we are clearly concerned. How carefully these have been

* The Cantor Lectures, delivered before the Society of Arts.

† Since the delivery of this lecture the work has been published, under the title of "The Principles of Animal Mechanics," by the Rev. Samuel Haughton, F.R.S., Fellow of Trinity College, Dublin, London: Longmans, Green, and Co. Dr. Haughton states in the preface that "the work is offered to the public with the view of showing the mutual advantage obtainable by anatomists and geometers from a combination of the sciences they cultivate. Anatomists will gain by the increased precision which numerical statements must give to their observations, and geometers will find in anatomy a new field of problems opened out to their investigations."

collected may be judged from the following. He writes, "This much I can guarantee, all the dissections, weighings, and observations have been made by my own hands, with every precaution of which I could think to ensure accuracy. My observations have also been made without preconceived hypothesis to guide them; and many of my most interesting results have been forced upon my notice by the facts placed before my eyes in the dissecting room and laboratory."

First, as to the expression "coefficient of muscular force." On the wall is a table of "coefficients of muscular force."

In the arm	94.7 lbs. per square inch.
" leg	110.4 lbs. " "
" abdomen	107.0 lbs. " "
Average	104.0

The term "coefficient" is a word of common occurrence in scientific investigation, and is plainly obtainable from "coefficienty." When we speak of coefficienty we mean "that two or more things combine to produce an effect." It is the figure by which a unit measurement is multiplied in order to produce a result. To find the coefficient of muscular force is to find some quantity which may be so combined with a measured area of muscle as that we can have a result on which to rely in reference to the question proposed. Adopting the view which the lectures on energy and gravity propounded, it may suffice for the present to say that the table on the wall tells us that, knowing the number of square inches contained in the cross section of any muscle, then multiplying these by the figures there stated, we obtain the weight which the particular muscle can, on sudden emergencies or for a very short space of time, sustain. It is the limit of endurance—it is the measure of lead which is just sufficient to cause the muscle to break—if a small weight more be added then the muscular fibres will be broken. It is the very extreme tension to which muscular fibre may be subjected without actual rupture. It is obtained by treating muscle as engineers treat wrought-iron rods when they seek to ascertain what load they can carry by tension. This explains that the table does not give a coefficient of work the muscles can do; such a coefficient depends upon the energy that vitality (or vital force, if the term be preferred) can infuse into the muscle; but, however great that vital power may be, the work done by the muscle must be less than that obtained in the table to which these remarks apply. A few words in illustration may not be misplaced.

We find from experiments, which would occupy far more than an hour to narrate, that in order really to tear 1 square inch of muscle across, it would require 94.7 lbs. in the arm, and in the leg 110.4 lbs. It is somewhat remarkable that in the arm, which does not carry the body, you have 94 as the strength of the muscle. When you come to those connected with the leg, which have to carry the body as well as do work, the fibres are very much stronger. Taking the average of the whole body, the coefficient of 1 square inch of muscle in the human frame is 104. Therefore if we know the size of any particular muscle and multiply it by 104, we get in lbs. weight the limit of strain it will endure before fracture.

Now the next question is, how much it will raise. In this view of the case motion enters. Supposing a fibre was in the form of a string, a very long one, and by contracting it will raise 2 lbs. weight through 10 feet. If, now, that fibre were doubled and only half the length, it would raise 4 lbs., but it would only lift it through half the space, because its power of contraction would be diminished by the doubling. Now, the products of the weight raised, and the distance through which it is raised, are the same in both cases. If it raises 2 lbs. through 20 feet, 40 would be the measure of that muscular exertion; and if it raised 20 lbs. through 2 feet, 40 would still be the measure; but the distances are different. After illustrating experimentally these statements, the

lecturer remarked that if an ounce of muscle be distributed with large sectional area, then its contraction will be little, but the weight raised may be great.

Muscle has also another peculiarity different from anything with which we can deal. If a bundle of it be taken, as you are aware, it acts by contraction; but while it contracts it does not change its bulk. It does not swell out as we understand the word—it merely contracts. Thus, if you had a long muscle acting in a vessel of water, and it contracted ever so powerfully, it would not in the slightest degree affect the level of the water in the vessel.

Now we come to the node in which the mechanical action of these combined muscular fibres is to be brought to a question of simple calculation. As far back as 1798 Dr. Wollaston occasionally observed a peculiar sound in his ears, for which he could not account. He pondered over this sound until about 1808, when a faint dawn began to enlighten the gloom. In 1809 he made clear to his friends what he was about, and in 1810 the results were published in the *Philosophical Transactions*. What he then did is the basis of all our present knowledge of this subject of muscular power.

Dr. Wollaston began to surmise that the sound in his ears arose from muscular contractions. He stated that he was led to infer the existence of intermittent contractions, from a sensation perceptible upon inserting the extremity of a finger in the ear. A sound is then perceived which resembles most nearly that of carriages at a great distance passing rapidly over the pavement. The sound is not dependent upon the degree of pressure upon the tympanum, for when the ear is stopped with great force without the presence of muscular action no such sound is produced. For instance, if the head press with its whole weight upon the ball of the thumb no noise is perceived unless the extremity of the thumb be at the same time pressed against the head, or some other muscle be brought into play. To judge of the frequency of this contractile action, he contrived to imitate the sound and to render the sound itself and the imitation audible by the same ear. It was accomplished thus. While the ear rested on the ball of the thumb the elbow was supported by a board lying horizontally, in which were cut notches about $\frac{1}{4}$ inch asunder similar to those in this board. By rubbing a pencil along these notches with a regular motion he imitated pretty correctly the tremor produced, and by counting the marks and noting the time, he found repeated observations agree with each other as nearly as could be expected. He also varied the experiment. One variety was this—the ear was stopped by a cushion pressed upon by the end of a notched stick that rested on his foot and conveyed the vibrations from the muscles of the leg to the ear along with the tremor produced by friction upon the notches; and still the results were nearly the same, viz., that the muscular vibrations resembled the sound of carriages at a distance. He induced many friends to repeat the experiments, and by going through the form of the experiment any one may, when convenient, satisfy himself. The humming sound will, of course, be perceptible only to the ears of the experimenter.

Put the first finger of each hand to the ears, not pressing them tightly, resting the elbows on a table thus, and then clench the fists firmly, you will immediately throw the muscles of the arm into action, and as soon as they are brought into action there is a peculiar humming sound perceptible. That is a sound caused much as the sound of flies, when buzzing about, is caused, or as humming birds cause their sound; it is caused by an intermittent action; in this case of the muscles, and upon that action, the rest of this lecture will turn. There is, however, a better plan even than that for observing this phenomenon. When you go to bed, if you are particularly bent on scientific research, and will lay your head on the pillow so as to entirely exclude all external sounds from the ear, then clench the teeth firmly, those muscles which are concerned in masticating the food are brought into play, and you hear the sound most distinctly. Now, that

sound gives a musical note, and from that musical note all our knowledge of muscular action springs. All musical notes are caused by the frequent repetition of a vibration at equal intervals. Here is a glass tube of some length, and a little jet of gas lighted. If the tube be placed over the gas-light you hear a musical note. That is caused by the light being extinguished and re-lighted a certain number of times per minute, as you can see by watching the reflection in the mirror. If, now, the mirror be shaken behind the light, a number of separate flames appear, if these are counted we can ascertain how often they occur in a minute or an hour. Therefore we know the number of beats which produce that musical note. Here is an instrument for causing a sound by the frequent interruption, at equal intervals of time, of a stream of air. The number of interruptions in a given time are recorded by the wheel-work and indicated on these dials. It is called a "Siren." Again, here is a gyroscope, which does the same thing. If some string be wound round, and it is set in rapid rotation, and then a piece of cane or quill be pressed against the little wheel at one end of the axle, the note produced will vary according to the speed of the rotation. Another illustration may be had from the heating of metals of certain peculiar-shaped surfaces, and laying them on cold metal, sometimes a peculiar humming sound is heard.

When Dr. Haughton was suffering from a singing in the ears after an attack of fever, he produced a sound by exercising the muscles of the jaws; this sound was in unison with the singing in the ears, but separated from it by several octaves. Dr. Haughton was struck, like Dr. Wollaston, with the resemblance of the sound to distant cabs. He measured the intervals of the granite pavement, and found them about 4 inches apart. This gave three impulses in the foot. If the cabs were driven at 8 miles per hour we have 35·2 impulses per second. An organ-pipe with a movable stop was tuned in unison, and thus 35·1·3 vibrations per second were deduced.

From this rate of muscular contraction Dr. Haughton deduces the amount of work stored up in human muscles. It may facilitate an explanation of the table and diagrams on the wall if, in as simple and clear a manner as in my power, the mode of conducting the experiments is described. Remember the object is to make clear to all not only the mode, but also the principles on which these experiments rest. Therefore every technical or professional term must, as far as possible, be avoided.

(To be continued.)

MISCELLANEOUS.

University of London—First B.Sc. and Preliminary Scientific M.B. Examinations.—The following are lists of candidates who have passed the recent Examinations for Honours:—*Mathematics and Mechanical Philosophy* (First B.A. and First B.Sc. conjointly).—First Class. M. J. M. Hill, First B.A. (Exhibition), University College. Third Class. J. Edwards, First B.A., Owens College; W. Fawcett, First B.A., private study (equal). *Chemistry* (First B.Sc. and Preliminary M.B. conjointly).—First Class. C. M. Thompson, First B.Sc. (Exhibition), University College; J. V. Jones, First B.Sc., University College; G. Christopher, First B.Sc., Owens College; P. P. Bedson, First B.Sc. and Prel. Sci., University College. Second Class. D. K. Jones, Prel. Sci., University College; S. A. Hill, First B.Sc. and Prel. Sci., Royal School of Mines; H. Davy, Prel. Sci., Guy's Hospital; H. Robson, First B.Sc. and Prel. Sci., University College. Third Class. W. Banks, Prel. Sci., private study; A. Daniel, Prel. Sci., University of Edinburgh; and J. W. Meek, Prel. Sci., Owens College (equal); C. Hopkinson, First B.Sc., Owens College, and O. J. Lodge, Prel. Sci., University College, private study, and J. K. Rogers, Prel. Sci., University College (equal); W. P. Mears, Prel. Sci., London

Hospital; T. F. Harris, First B.Sc., private study. *Experimental Physics*.—First Class. O. J. Lodge, First B.Sc. and Prel. Sci., private study. Second Class. H. Sainsbury, Prel. Sci., University College. Third Class. D. R. Jones, Prel. Sci., University College; J. V. Jones, First B.Sc., University College. *Organic Chemistry, and Materia Medica and Pharmaceutical Chemistry* (First M.B.).—First Class. A. H. Jones (Exhibition and Gold Medal), Guy's Hospital; A. J. Pepper (Gold Medal), University College. Second Class. T. K. Rogers, University College; C. L. Jones, Guy's Hospital, and E. W. White, King's College.

CORRESPONDENCE.

THE NESSLER REACTION.

To the Editor of the Chemical News.

SIR,—The Nessler reaction appears very unmanageable in some hands; you will therefore probably admit the value of the following simple suggestion:—In diluting the stock standard sulphate of ammonia solution, and also in making the Nessler comparisons, use, instead of pure distilled water, distilled water which has been recently boiled after the addition of some caustic potash.

This is a ready means of getting water free from ammonia, and considerably heightens the sharpness of the comparison texts. I have adopted the plan some years.—I am, &c.,

SIDNEY W. RICH.

Laboratory, 1A, Chenies Street, W.C.

NOTES AND QUERIES.

Anthraxen.—In experimenting with this substance I endeavoured to prepare the pure material by sublimation from the residue left on digesting crude anthracen in alcohol (sp. gr. 825), which residue contains 90 to 100 per cent pure anthracen. In this way I obtained a product, yellowish-white and snow-like, being exactly like the anthracen which crystallises from benzol (90 per cent), but on testing its melting-point, I found it to be below 180° C., instead of 210° C., the melting-point of pure anthracen, according to most authors. My explanation to give for this I really do not know, unless it is that the product is a mixture of anthracen and naphthalin, but the latter body should have been completely washed out, 400 c.c. of alcohol having been used in washing only 20 grms. of the crude pressed anthracen, and of this, after washing and drying, only 68 grms. of insoluble matter remained. At the same time I obtained, as I have repeatedly on other experiments, a most beautiful colour of thin, iridescent, transparent plates: these I have often found attached to the under surface of the filter-paper on which I have been drying anthracen. I shall be glad, if any other readers of your valuable paper have made similar experiments, if they will forward their results and inferences. On a future occasion I shall have great pleasure in sending an account of any other experiments I have made on anthracen which will be more worthy of publication than this short account may be.—T. H. D.

Notes on the Utilisation of Sewage.—

97. (To Mr. Baralgette). What is the total amount in tons of the sewage of the northern side of the Metropolis?—The sewage on the north side is altogether 87,000,000 gallons per diem.

98. (To the same). How much would be in a year?—It is probably worked out pretty correct in page 106 of this report of the Main Drainage Committee, where it is stated the annual volume of the sewage on the north side amounts to 36,957,285,000 gallons.

99. How many tons would that be in the year?—168,033,115 tons, 104. (To Mr. Thwaites). The greater part of those 168,033,115 tons of sewage would be discharged on the 20,000 acres of sands, would they not?—I believe they did intend to discharge there.

100. If they did you would allow, would you not, that it would be nearly seven feet deep if it were all collected there at once?—No doubt.

223. (To Mr. Thwaites). Are you aware that Messrs. Hofmann and Witt have stated that the liquid contains six-sevenths of the sewage in solution, and that there is only one-seventh in the mud?—I believe that that is so.

356. (To the same). Are you aware that Messrs. Hofmann and Witt have stated, and that those who made this report have corroborated in that statement, that 1250 tons of liquid sewage are equal in value to one ton of guano?—Yes.

350. (To Mr. Baralgette). When would you put the sewage over the land between the Abbey Mills and the Maplin sands, during the whole of the year?—I can hardly conceive that the sewage would be applicable to the land during the whole of the year.

351. (To the same). What would you do with it at those times as which it was not applicable to the land?—I should take it at the present outlet.

509. (To Mr. Heman). I suppose you are aware that in eight hours out of the 24 the half of the sewage flows?—I am aware that there is a larger proportion at one period of the 24 hours than there is at another.

512. (To the same). Then if the half of it flows in eight hours, that would be 250 cubic feet per acre in eight hours?—Supposing the half to come in eight hours it would be 250 cubic feet.

513. (To Mr. Heman). What would be the thickness of this per acre per annum?—It comes to seven feet per acre per annum.

514. (To Mr. Heman). Do you confirm that?—On 12,000 acres only it would be seven feet thick, but on 20,000 acres it is four feet per acre per annum.

515. (To Mr. Hopel). You have stated that the Edinburgh experiments were a great success?—Yes.

758. (To the same). To whom have these experiments been a great success?—To the proprietors.

759. (To the same). They have not been a great success to the ratepayers?—Certainly not; they get no benefit whatever from the arrangement.

762. (To the same). But with regard to the value of the sewage to the town of Edinburgh, do they receive anything for it?—Nothing. The sewage flows into a natural stream, which happens to pass through this farm; and passing through the farm they have gradually adopted it for irrigation, and extended the system, as they found it paid better than ordinary cultivation.

783. (To the same). How many tons of sewage do you propose to distribute on the Maplin Sands?—If the whole of the sewage is placed there, it would be about 2000 tons per acre per annum.

785. (To Mr. Heman). It has been stated that the value of the sewage has been computed at 6s. per acre if the population; upon what estimate is that calculation based?—I believe that that is based upon a very long series of experiments by a number of different chemists, but that is only the theoretical value.

846. Has that any reference to the expense of carrying the sewage from the place at which it is thrown into the river to the place of its application?—None whatever.

(Report of the Main Drainage Committee for 1864, vol. 487.)

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the manufacture of white-lead, and in the purification of carbonic acid, and in the use of the same in manufacturing, and in apparatus therefor. George Haselstine, Southampton Buildings, London. (A communication from Asa P. Meyler, New Britain, Connecticut, U.S.A.) January 18, 1873.—No. 213. My invention relates to an improved method of purifying the carbonic acid gas used in the said manufacture. I use an apparatus whereby the carbonic acid gas required for corroding the lead is used to assist in conveying the vapour of acetic acid, and the apparatus is also used to assist in vapourising the acetic acid required for corrosion. The method of manufacturing white-lead by the said apparatus is as follows:—Thin strips or pieces of lead of any convenient size are placed in a suitable chamber or house. At any convenient distance from this chamber and connected thereto by a pipe or pipes, or within the chamber itself, is placed a vessel, reservoir, or receptacle of any suitable form or shape containing acetic acid of any suitable strength; carbonic acid gas, either pure or mixed with oxygen or with common hydrogen, is forced through a suitable pipe or pipes into the said receptacle containing acetic acid, the gas being passed through or over the acid and then passed from the said receptacle free into the room containing metallic lead for corrosion; steam is likewise introduced at any convenient point and mingled with the gas and vapour.

An improved process and apparatus for extracting and recovering oils, fats, and similar substances. John Cox, analytical chemist, Newcastle-on-Tyne, and Samuel Cox, by hydraulic engineer, Hatfield Road, Surrey. January 18, 1873.—No. 214. Our said invention relates to the extraction and recovery of oils, fats, spermaceti, paraffin, wax, and other like substances by the action of a volatile solvent passed by distillation through materials containing these oils, fatty, or other substances, the said volatile solvent being recovered after each operation.

A process for forming carbonic oxide from oxyhydrogen vapour or steam, and an apparatus for utilising the same for heating purposes. Levi Stevens, San Francisco, U.S.A. January 18, 1873.—No. 216. This invention consists in the discovery of the conditions by which carbonic oxide or protoxide of carbon is formed from oxyhydrogen vapours or steam. Also in distilling bituminous coal, asphaltum, pine-wood, and in fact any substance that will distil a carbon or hydrocarbon vapour or gas, which vapour or gas is used in the disintegration of oxyhydrogen vapour or steam. The invention further consists in the application of carbonic acid or protoxide thus formed to steam-boilers, furnaces, and all places where heat is required, this being effected by the use of any suitable form of retorts, which are set up as to be heated by the same furnaces which serve for the steam-boilers. These retorts are charged with any suitable or convenient substance which will produce a carbon or hydrocarbon vapour by distillation and at the proper time. Superheated steam (from an apparatus supplied by the furnaces) is let in at a temperature at which the carbon is decomposed. Protoxide of carbon and free hydrogen are thus evolved, and the gases thus produced are led by suitable pipes into the furnaces.

Provision is also made for the introduction of oxygen from the air for the complete combustion of the gases thus introduced.

Improvements in stoppering bottles for arolic or gaseous liquids. Charles Farrow, mechanical engineer, Great Tower Street, London. January 18, 1873.—No. 218. This improved stopper is formed by attaching to the ordinary bottle a tube of flexible or elastic material, such as india-rubber, or india-rubber lined with linen, one end of this tube being passed over and attached to the neck of the bottle by string or wire. To close the bottle, the upper part of the tube may be either doubled down and tied, or strangled.

A method of measuring in sediment or cistern barometers, and in the means of filling the same. Christopher George, Staff Commander R.N., Herne Hill, Surrey, and Henry Porter, optician, Strand, Middlesex. January 18, 1873.—No. 224. The cistern is made open at bottom, so that when filled to the mouth of the tube, and the tube inverted, the mercury may be lowered into the tube without the use of a funnel, a twisted or spiral cord having been first introduced into the tube. This cord has a brush or feather at its extremity, which reaches the closed end of the tube, and the mercury on being poured in is broken up into globules, which are driven down the cord and the sides of the tube. The cord is then rotated in the tube, which raises it out of the mercury, bringing with it all air-bubbles. When the tube is filled, the cistern is closed by a vulcanised india-rubber stopper, and the instrument brought to its proper position.

A new or improved charcoal to be used for purifying sewage and other foul waters, and for disinfecting and deodorising purposes. James Kobey, sugar refiner, Manchester. January 20, 1873.—No. 230. The features of novelty in this invention consist in the use of a charcoal precipitant or precipitant obtained by treating sewage after the manner of the Native Guano Company, Limited, when practising according to either of the two patents granted to Messrs. Silar and Wigner, bearing dates 1855, 1858, and 1859, No. 1954, 1858, and No. 1955, 1859, No. 1870, No. 1870, No. 1874, in both of which patents clay is the principal precipitant, or the sludge or precipitant obtained by treating sewage by either precipitating processes in which clay is used, and so producing a charcoal which is useful for the various purposes described; or a similar charcoal is produced by mixing clay with the refuse carbonaceous matter from prussiate of potash manufactories, and then charring the mixture.

An improved process for obtaining salt of tin and other products from waste or refuse or said tin-plating. Adolf Guttensohn, analyst, Gresham House, London. January 22, 1873.—No. 238. I use a vessel made of any material not affected by the action of acids. In this vessel I place the tin-plate or refuse with muriatic acid until it has acquired a dull grey colour, the acid is then poured off into a second vessel containing the same weight of tin-plate waste; here it again remains till the colour of the waste is dull grey; after which the same process is repeated in a third vessel. Ammoniac is added until, on testing with a solution of caustic soda, it is found to be neutralised. A further quantity of the solution of extract of indigo is then added until the deposit ceases to be formed. The solution is then allowed to boil for a few minutes, and then filtered. This solution is then evaporated, and the salt allowed to crystallise. Metallic tin is obtained from the purified salt of tin by means of zinc.

Improvements in the manufacture of incombustible paper, in ink for writing on the same, and in covers and envelopes for the said paper or other paper when made into books or packages. George William Hall, of London, and John Shadwell, Middlesex. January 23, 1873.—No. 262. The chief features of novelty in this invention are—First. The making of a paper which shall be ordinarily incombustible under such circumstances as fires occurring in dwelling-houses, factories, and other buildings. The paper is composed chiefly of the following ingredients, viz., lichen or vegetable fibre and asbestos with borax and alum, to which is sometimes added a small quantity of ground or powdered glass and of common salt. Secondly. An ink for writing on the above paper made from the mineral or metallic salts. Thirdly. Incombustible covers or envelopes for books and packages made from the incombustible pulp or paper with or without sheets of talc or sheets of talc with or without the incombustible paper.

Improvements in treating sewage for the purpose of making manure and fertilisers. Frederick Jacobson, Redfern House, Edinburgh. January 23, 1873.—No. 266. Mixing phosphate of lime along with diluted sulphuric acid, which sulphuric acid is not diluted with sewage instead of with clean water, whereby a superphosphate is produced, which is then mixed with the sewage, which is so obtained by any of the known methods for producing subsideance and decantation.

TO CORRESPONDENTS.

- * * THE STUDENTS' NUMBER OF THE CHEMICAL NEWS will be published on Friday, September 21st, and will contain the holding of examinations in the Universities, Medical Schools, &c., of the United Kingdom, where Chemistry and Physical Science form a part of the Education, who have not yet forwarded the necessary information to our office for publication in this number, will confer favour on us by sending it with the earliest possible day.
- * * Vol. XXVII. of the CHEMICAL NEWS, containing a copious index, is now ready, price 11s. 6d., by post, 12s., handsomely bound in cloth, gold lettered. The cases for binding may be obtained at 10s. 6d. per volume. Subscribers who are desirous of having their copies bound for 2s. 6d. if sent to our office, or, if accompanied by a cloth case, for 3s. Subscribers wishing to complete their sets of volumes are requested to apply to the publisher, who will give them the proper time for ordering. The subscription for 1873-4 commenced on July 4th, and will be complete in twenty-six numbers. READING CASES, price 1s. 6d. each, post free, may also be obtained at the Office.

SUPPLEMENT TO THE CHEMICAL NEWS.

VOL. XXVIII. No. 719.

ESTIMATION OF HYDROSULPHURIC ACID IN MINERAL WATERS.

By W. J. LAND.

In an apartment free from direct sunlight, preferably a room lighted by non-actinic rays, prepare a moist precipitate of pure carbonate of silver, by dissolving 8.5 grms. of pure nitrate of silver in one-fourth of a litre of distilled water; also, 2.7 grms. of chem. pure dry carbonate of soda in an equal volume of distilled water previously heated to about 180° F. Mix the solutions (gradually), simultaneously stirring the mixed solutions with a glass rod. Allow the precipitate to subside, decant the supernatant liquid with a pipette or small syphon, wash with hot distilled water, decanting and washing successively five or six times to obtain a comparatively clean precipitate of carbonate of silver, in which substance we have a most excellent reagent for removing every trace of hydrosulphuric acid, small quantities of alkaline sulphides and haloids, from their solution in water. Add, to a definite quantity of the water to be operated upon (say 1 litre if strongly impregnated, and to litres if weakly impregnated with gas), the still moist precipitate or magma of carb. of silver, until the precipitate, at first black in colour, becomes brown or greyish-brown, thus indicating an excess (as desired), of the silver salt. Shake or stir well, warm gently, and allow the precipitate to subside perfectly. Decant the greater part of the liquid, transfer the remainder of the liquid with every trace of the precipitate to a small beaker, and digest the latter with pure dilute nitric acid (1 of acid to about 4 of water), thus removing the excess of carbonate of silver. Decant and wash well with distilled water. Transfer to a weighed filter, wash with a moderately dilute solution of hydrate of ammonia (to remove silver haloids), testing the ammoniacal filtrate occasionally with sulphide of ammonium, or other suitable reagent, to discover the presence or absence of the silver haloids in the washings; when all traces of these have disappeared, wash well with distilled water; lastly, with pure 95 per cent alcohol, dry on a water-bath. Remove the dried sulphide of silver from the filter, ignite the latter in a small porcelain crucible with a grain or two of sulphur; heating to incipient redness (to expel excess of sulphur), add the ignited product to the larger quantity of the precipitate, transfer to a desiccator, afterwards weigh. 124 of the sulphide corresponds to 17 of hydrosulphuric acid sought.—*American Chemist*.

NOTICES OF BOOKS.

The Chemistry of Sulphuric Acid Manufacture. By H. A. SMITH. London: E. and F. N. Spon.

THAT sulphuric acid plays in chemical manufactures a part analogous to that sustained by iron in the mechanical arts is not to be disputed. Such being the case it is surprising that every point connected with its production has not been thoroughly studied both from a theoretical and practical point of view. Yet the author of this useful little work says no more than the truth when he declares

that:—"The interior of the lead chamber is comparatively an unknown land to us." Mr. Smith, in the brief compass of 81 pages, has made a very praiseworthy attempt to supply this deficiency in our knowledge, and we hope that he may find time and opportunities to carry out and complete what he has so well begun.

The first part of the work is devoted to a consideration of the presence of arsenic in the sulphur ores commonly employed. The amount of this serious impurity he finds to be greater than is generally stated in standard works, ranging from 0.943 per cent in Belgian pyrites to 1.878 in Westphalia. The author's determinations certainly accord much better with the amount of arsenious acid present in commercial sulphuric acid, hydrochloric acid, salt-cake, and other products and residues implicated than do the analyses given in Richardson and Watts's "Chemical Technology." In that important work the highest mean percentage of arsenic is described as ranging from 0.31 to 0.33, whilst some pyrites are described as containing mere traces, and others as perfectly pure, "results which," our author remarks, "are never corroborated when these ores are being worked on a manufacturing scale." The means for preventing the escape of arsenious acid into the atmosphere, and of removing it from sulphuric acid, are carefully investigated. The preference is given to the use of sulphuretted hydrogen, though the mode of its application is still an open question.

We next come to an "experimental examination of the circumstances which determine the action, *inter se*, of the gases in the lead chamber." The author, founding on careful experiments, controverts the common view that no action can take place between oxygen and sulphurous acid gases without the intervention of water, either in the liquid or gaseous state. He finds, on the contrary, that "action does take place between the dry gases under certain circumstances." He draws here the general practical rule that, "the higher the temperature the more steam is required."

In successive sections we find experimental investigations into the distribution of gases in the lead chambers, the temperature at which nitric acid acts upon sulphuric acid, the distribution of heat in the chambers, and an inquiry into the best form of chamber. We quote the following as his practical conclusions:—

1. The best form of chamber is one which is long and not high, of somewhat the following dimensions:—Length 150 feet, width 25 to 30 feet, height 10 or 12 feet.
2. The temperature of the chamber should be kept as nearly as possible about 200° F.; this fact also acting as a regulator for the amount of steam thrown into the chamber.
3. That in "starting" a chamber sulphuric acid should be run on the bottom in preference to water as at present generally employed."

In a final section on the Gay-Lussac tower and the escape of sulphurous acid to the atmosphere, he condemns the tower on the following just principle:—"Instead of a careful inquiry into the cause of the escape of nitric oxide, we take it as a recognised fact that such a gas must escape, and that our only hope rests in some method of absorbing it. Referring to the present escape of sulphurous acid from alkali works, the author recommends a prohibitory law similar to the Alkali Act. Whilst fully admitting both the nuisance and the waste thus occasioned, we cannot help asking what proportion does the sulphurous acid escaping from chemical works bear to that evolved from the pyrites present in coal? Our conviction is, that in any district where the highly sulphurous Lancashire coal is used the former is a mere "drop in the bucket."

We strongly recommend this treatise to all of our readers who are interested in the manufacture of sulphuric acid, and we hope that its practical, experimental spirit may be reproduced by writers on other departments of chemical technology.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopaedic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, August 11, 1873.

On Cyanides.—M. Berthelot.—A continuation of the thermo-chemical investigations with which the author has been occupied for some time. The author mentions as an important instance of an "inverse displacement" that hydrocyanic acid displaces hydrochloric acid from combination with the oxide of mercury. On the other hand, concentrated hydrochloric acid, and even hydrochloric gas, expel immediately, and at ordinary temperatures hydrocyanic acid from cyanide of mercury; and dilute aqueous hydrochloric acid completely decomposes cyanide of potassium in solution. These facts, he contends, are in perfect accord with his theory.

Re-solution of Precipitates.—M. Berthelot.—The theory of Berthelot as given in his "Statique Chimique" is that if we treat a dissolved salt with an acid capable of forming an insoluble salt with its base the latter is generated in consequence of the partition of the base between the two acids, and is then precipitated in virtue of its insolubility. The separation of this body having withdrawn it from the field of chemical action, a fresh partition of the base takes place between the two acids in the liquid, and consequently a fresh precipitation. This is still the admitted law of the science. The thermic theory, on the other hand, reproduces the notion of an elective affinity; the work done by which is measured by the heat liberated in the reactions of the bodies taken in comparable states. If the bodies were isolated from every solvent, and if each acid formed with the base only one single compound, there would be no partition—contrary to the opinion of Berthelot—and, in consequence, insolubility would not play any part in chemical statics. It would be the same in the presence of water if none of the compounds formed in its absence did not undergo decomposition on its part. But there are acids capable of forming several compounds with one and the same base. Further, water decomposes in part according to its mass, and to the relative proportions of acid and of base, the acid and the basic salts, the ammoniacal and the metallic salts, &c. These circumstances determine intermediate equilibria; that is to say, a varying partition of the base between the two acids. In solutions, and for soluble salts, the reality of this partition can be established by thermic evidence (*Comptes Rendus*, tome lxxv., p. 435, 480, 508, 583; tome lxxvi., p. 94); or by the method of two solvents (*Annales de Chimie et de Physique*, 4 series, tome xxvi., p. 433). To decide between these theories we must seek cases where they lead to conflicting results, such as those where each of the two antagonistic acids forms only a single basic compound stable in presence of water. The proof is realised by mixing acetate of silver and dilute nitric acid, when the insoluble acetate is immediately changed into dissolved nitrate. It would be easy to multiply analogous examples of the complete displacement of a monobasic acid in an insoluble salt by a single equivalent of another monobasic acid which forms an insoluble salt. The decomposition of insoluble carbonates by monobasic acids, such as the hydrochloric and nitric, in liquids either concentrated or so dilute that the carbonic acid may remain dissolved, is equally total. In dilute solutions it gives rise some-

times to a liberation of heat, sometimes to an absorption (carbonate of silver and nitric acid). The decomposition of the insoluble carbonates falls under the foregoing theory. Such results may serve as a criterium between the theory of Berthelot and the new thermic theory.

Methods of Analysing the Natural Phosphates employed in Agriculture.—M. C. Ménè.—The author has already called attention to the analysis of phosphates by the "ammonia" and the "citric acid" (or acetic) methods, and to the erroneous results to which these methods may lead (*Comptes Rendus* tome lxxvi., p. 1410). He now produces results of analyses made in his laboratory which confirm what he formerly announced. Coprolites from the Department Nord, found to contain 45 per cent of tricalcic phosphate by the citric acid and ammonia phosphate of magnesia process, gave only traces of phosphoric acid by the "bismuth process." Other phosphates from the Rhone giving 53 per cent of phosphate by the citric method, did not yield even a trace of phosphoric acid by the bismuth process. If an attempt was made to check the results obtained by the former method by re-dissolving the precipitate, and trying to produce other reactions no phosphoric acid could be found. On the contrary, it appeared that this precipitate was silica and alumina. If any one goes over the details of the process he will see that the ammoniacal liquor which serves to precipitate the ammonia phosphate of magnesia, throws down also alumina and silica, and that in the absence of phosphoric acid these two bases (?) may simulate its presence. The author, however, does not attack the citric acid method in cases where silica and alumina are absent, having frequently obtained by its means with the phosphates of the Antilles, and of Limburg, with bones, &c., results quite comparable to those given by the bismuth process. He considers that bismuth precipitates phosphoric acid so quickly and certainly that no other reagent can be compared with it. In many determinations he has never found a deviation of more than 0.25 per cent, which is commercially inappreciable.

On Fluoren.—M. Barbier.—Fluoren, a new and highly fluorescent carbide, is contained in the parts of coal-tar which are volatile between 300° and 340°; its formula is $C_{20}H_{10}$. On treatment with chlorine it forms a bibromic derivative, $C_{20}H_8Br_2$, fusible at 166° to 167°, and crystallising in splendid tables belonging to the clinorhombic system.

Corindon of North Carolina, Georgia, and Montana.—Lawrence Smith.—Specimens of this mineral have been found in crystals of a pyramidal form. They vary greatly in colour, being grey, green, rose, blue, red, with all intermediate shades. Diaspore, so abundantly associated with corindon at Chester (Massachusetts), has not been found accompanying it here. Specimens supposed to be diaspore were colourless kyanite. Chlorite envelopes and penetrates the corindon. Its composition is—

	Large Plates.	Friable.
Silica	27.00	29.15
Alumina	21.60	10.50
Oxide of iron ..	16.63	23.50
Magnesia	22.00	25.44
Water	12.30	10.04

Margarite (emerylite) accompanies corindon or emery everywhere; in the present localities it is abundant. Its composition is:—

Silica	32.41
Alumina	51.31
Lime	10.98
Soda	2.43
Water	2.13

Zoisite.—This mineral appears in two forms; a black and a transparent green variety. Both of these have been called *Arfvedsonite*, but neither has the composition of that mineral. The following is the composition of three kinds:—

	Transparent Green.	From Gruva.	Black Variety.
Silica	45.70	43.59	45.90
Alumina	24.01	27.72	13.34
Peroxide of iron ..	4.56	2.61	11.46
Lime	13.34	21.00	12.20
Magnesia	8.03	2.40	12.53
Soda	2.91	3.08	3.39
Water	0.60	—	0.66
Chromic oxide ..	0.52	—	—

Andesite.—This mineral is found in a granular form. Its composition is—

Silica	64.12
Alumina	24.20
Soda	9.28
Lime	2.80
Oxide of iron ..	0.14

Action of Platinum and Palladium on the Hydrocarbons.—J. J. Coquilhon.—It is known that a spiral platinum wire, previously heated to redness and placed in contact with vapours of alcohol or ether, gives rise to a variety of products, of which the chief are aldehyd and acetic acid. All the mono-atomic alcohols and their ethers act in an analogous manner, producing the aldehyd and the acid corresponding to the alcohol. All the hydrocarbons, the volatile oils, anilin, &c., maintain the incandescence of the platinum spiral. The fixed oils, the sulphuretted oils, such as those of garlic and mustard, seem to form an exception. The author has collected the products of combustion in the case of three substances belonging to three different series—toluen, C_6H_6 , of the series C_8H_{10} —naphthalene, $C_{10}H_8$, of the series $C_{10}H_{12}$ — α -naphthalene, $C_{10}H_8$, of the series $C_{10}H_{12}$. Toluene gives up 2 equivalents of hydrogen to form water with the oxygen, and yields aldehyd and benzoic acid. For naphthalene, formic acid, and ethylene produces acetic acid. The action of palladium is more powerful than that of platinum. It becomes wrinkled on its surface, and breaks easily after having been in use for some days; moreover, it loses weight very distinctly.

Reply to Recent Objections of M. Tacchini (Solar Physics).—M. Faye.—First, as to penumbrae. M. Faye's theory is that they are due to a lowering of temperature about the solar vortices. The photosphere somewhat altered is continued to a certain depth in the form of a sheath round the vortices. When by some accident, as sudden increase of intensity, or extended rotation, these conical walls are reached they may take for a time a well-marked vertical movement; but in general they have only a slight hardly perceptible rotation. Hence it is not surprising that in the first five months of the present year, M. Tacchini observed only six cases of vortical structure. Again, M. Tacchini supposes M. Faye's theory requires a symmetry in the mode of rise of the hydrogen in the spots, and that there should always be a well-formed corona of protuberances. M. Faye rejects this idea; the sun's structure, and the analogy of terrestrial cyclones are both against it. M. Faye is represented, thirdly, as holding that there are never protuberances without spots. He quotes various passages from his writings contradicting this.

Direct Demonstration of the Fundamental Principles of Thermo-Dynamics.—Continued extract from memoir by M. Leduc.—It treats of quantities which characterise—(1) The absolute temperature of a body; (2) its physical and constitutive state.

Detailed Geological Map of France.—M. Elie de Beaumont.

Note on the Public Works of the United States of America.—M. Belgrand.—The author notices some points (referring to bridges, water-works, railways), in the report of M. Malesieux, a French engineer sent over by the Government in 1870.

Propagation of the Tide at Different Points on the French Coast.—M. L. Gaussin.—(Extract from memoir.)

—The author examines the tidal phenomena in about a dozen French harbours and four English. As to ocean ports (Cordouan, Saint Nazaire, Port Louis, &c.) the tide is propagated more slowly in still than in current water. In the Channel, on the contrary, except at Havre, the tide arrives more quickly in still water on both coasts. Further North on the German Ocean, at Calais, and at Dunkirk the former *regime* recurs. The author gives the average variations of retardation in the daily tides, the syzyzidal tide being taken as normal type. Comparing the curve for Havre with that for the neighbouring port of Fecamp, the minimum for the former and maximum for the latter takes at syzyzies; the Havre minimum, + 34 m., corresponds to the Brest tide of 11h. 30m.; the Fecamp minimum, - 23m., corresponds to the tide of 11h. The difference of variations of retardation in the propagation of the tide in the two ports is thus, in relation to the tide in current water, 57m. in still water. Formerly, before certain embankments were constructed in the Seine, it was only 33m. There is, besides, an absolute change at Havre. In current water the full sea reaches Havre 36m. more quickly than before. These changes are attributed to considerable diminution in the beaches of the Seine estuary, which have exerted a retardative action, and do still, though in less degree.

Passage of Gases through Colloidal Membranes of Vegetable Origin.—M. A. Barthelemy.—The author repeated the experiments which Graham made with caoutchouc, with leaves of certain varieties of *Begoniaceae*. Though it was difficult to preserve in the several experiments the same conditions of external pressure, temperature, and hygrometric state, the numbers sufficiently show that oxygen passes more quickly than nitrogen, and that air thus dialysed contains, on an average, 36 per cent oxygen (a number slightly under that which Graham obtained with caoutchouc). In another experiment, having made CO_2 pass over the membrane, he marked the point to which mercury descended in an hour; then passing nitrogen or oxygen, he marked how long the mercury took to descend to the same level. The results closely agreed with Graham's; and warrant the conclusion that the natural colloidal surfaces of plants have for CO_2 an admissible power 13 to 15 times greater than that for nitrogen, and 6 to 7 times greater than that for oxygen. Carbonic anhydride passes less quickly than hydrated carbonic acid. The author remarks that "cuticular respiration appears sufficiently proved by the presence of colloidal membrane in all organs; by the similarity (physical and chemical) between this membrane and caoutchouc; by Graham's experiments; by measurements of the passage of gas through colloidal membrane; and last by M. Boussingault's experiments, which attribute to the upper surface of leaves, devoid of stomates, a decomposing power greater than that of the under face covered with these small orifices."

Variations of Hæmoglobin in Disease.—M. Quinquaud.—In a healthy person the proportion of hæmoglobin is about 125 to 130 grs. per 1000 grs. of blood. But it varies very much in disease; sometimes, as in cancer, falling as low as 39 grs. It may thus serve, M. Quinquaud thinks, in diagnosis and prognosis. He gives several instances, and adds a determination of the hæmoglobin for some twenty different kinds of disease. Cancer, chlorosis, and tubercular phthisis of the third degree, are those which diminish the proportion most.

Revue Scientifique de la France et de l'Etranger,
August 9 and 23, 1873.

These numbers contain no original chemical matter.

No. 9, August 30.

Meeting of the French Association for the Advancement of Science at Lyons.—(Chemical Section).—Session of August 22.—M. Gautier described a new derivative of glucose, $C_{12}H_{22}O_{11}$, obtained by the action

of hydrochloric acid. The glucose is dissolved in alcohol at 95 per cent, and the solution saturated with hydrochloric acid, keeping the temperature at 0°. The mixture, after having been kept cold for twenty-four hours, is evaporated over lime in a vacuum, when there remains a syrup which is purified by washings in ether, treatment with baryta, and successive solutions and evaporations in absolute alcohol. The compound is a white, crystalline, solid, deliquescent mass, without taste, incapable of fermentation, reducing cupro-potassic liquid, and not capable of becoming hydrated below 160°, when it is converted into a body differing from glucose. This compound, resulting from the union of two molecules of glucose with the elimination of a molecule of water, does not appear to be an ether of glucose viewed as an alcohol, but as a body like aldol, analogous to the products yielded by the aldehydes. M. Gautier proposes to give it the name glycaldan.

With reference to this paper M. Wurtz explained the constitutional formulæ of glucose, which explains its double function as a pentatomic alcohol and as an aldehyd.

E. Grimaux stated that Musculus had obtained by the action of sulphuric acid upon glucose a body which appeared to be dextrin; resulting from the union of two molecules of glucose, performing the functions of an alcohol, with separation of a molecule of water.

Ch. Girard presented to the section specimens of certain coal-tar colours, such as rosanaphthylamin, saffranin, Paris violet, &c., and described the method of their preparation.

M. Carnot described a deposit of bismuth which is worked at present at Cortezze. It consists of metallic bismuth, oxide, and sulphide. The oxide is the most abundant ore, and contains 70 per cent of bismuth. The process of extraction consists in exhaustion with hydrochloric acid, and precipitation by means of iron. The bismuth then undergoes the ordinary treatment for the removal of lead and arsenic. The stratum contains also molybdate of lead, tungstate of lime, and mispickel.

M. Friedel has examined two samples of rich tellurium ores from Asia Minor. The ore is a telluride of gold and silver, containing 21 per cent of gold, and 37 per cent of silver. The other is a telluride of lead.

M. Grimaux described the action of bromine upon dimethylbenzin or xylene, $C_6H_4(C_6H_5)_2$, at the temperature of 140°. He showed that whilst forming a brominated derivative, the bromine substitutes itself in the two groups CH_3 , yielding a dihydrobromic ether of glycol. The author announced that he had observed the same reaction with ethylbenzin, $C_6H_5-CH_2-CH_3$, which yields a derivative, $C_6H_5-CHBr-CH_2Br$, identical with the bromide of cinnamon. This bromide, on boiling with water, loses all its bromine in the state of hydrobromic acid, and forms a very soluble crystalline body, probably cinnamic glycol. The same procedure, applied to trimethylbenzin or to ethyl-methylbenzin, would doubtless lead to the formation of a tribromohydrin of an aromatic glycerin, but the author has had recourse to another reaction for the production of the latter.

Cinnamic alcohol or styron, $C_9H_{10}O$, may be considered as phenyl-allylic alcohol. Like allylic alcohol it fixes 2 atoms of bromine, and yields a crystalline dibromohydrin, $C_9H_{10}Br_2O$. Grimaux has also obtained tribromohydrin, aceto-dibromohydrin, and chloro-dibromohydrin, all crystalline. Triacetin is a syrup-like liquid. The glycerin, $C_3H_5O_3$, obtained by the action of water upon dibromohydrin is a soft transparent gummy substance of a bitter taste, very soluble in water, and which behaves with formic acid similar to the polyatomic alcohols, setting free carbonic acid. The author gives to this glycerin the name of styricin.

Revue Hebdomadaire de Chimie Scientifique et Industrielle
par Ch. Ménie, May 22, 29, and June 5, 1873.

These numbers contain nothing of interest to our readers.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, No. 229, September, 1873.

Report given in by M. Salvétat for the Committee of the Chemical Arts on a New Form of Muffle for Burning Designs on Porcelain, Earthenware, Glass, and Crystal.—M. Pollard, at Auteuil.—This paper would not be intelligible without the accompanying diagrams.

Report Given in by Hervé Mangon for the Committee of Agriculture on the Procedures of Preparing Animal Matters Designed for the Manufacture of Manures.—M. Coignet.—Horns, hoofs, hair, refuse of tanned hides, and woollen rags are very rich in nitrogen and other fertilising ingredients; but the difficulty of reducing these matters to a fine powder so as to mix with the soil, and the extreme slowness of their decomposition in the ground, prevent them from giving a profit in proportion to the value of their constituents. M. Coignet seeks to overcome these difficulties as follows:—Leather waste of all sorts, horn, and analogous matters are introduced into a stove of about 20 cubic metres in capacity. This stove is of sheet-iron. It has at its upper part a door for charging, and a side door below for emptying. A floor of bricks is formed at some decimetres above the bottom of the stove. The lower part of the stoves communicates, by means of a large sheet-iron pipe, with the chimney of the works, or with an aspirating ventilator. By the side of the stove is a rectangular furnace in which coke is burnt, the chimney of which opens into the upper part of the stove above-mentioned. The hot air and the products of combustion traverse the contents of the stove from the top to the bottom. When the stove is filled, and its doors are closed and luted, the furnace is kindled, and the doors placed above the fire are opened so that a large volume of air may enter the stove at a temperature not exceeding 150°. When the whole mass of the stove has reached this temperature the furnace is well charged with coke, and its doors are closed so as merely to admit air sufficient to prevent it from being extinguished. At the same time a current of steam is allowed to enter the chimney (leading from the furnace to the stove). This steam mixes with the products of combustion, and traverses thus the stove at a temperature of 150° to 160°. After some hours of this treatment the horn, leather, &c., is found slightly swelled, and quite dry and friable, without having lost any nitrogen. The mass is allowed to cool, withdrawn from the stove, powdered under edge-stones and sifted.

On Blast-Furnaces.—M. L. Gruner, Inspector-General of Mines.—A long and important paper, with several illustrations, and not suited for abstraction.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, Tome xxxi., No. 17, August 21, 1873.
This number contains no original chemical matter.

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London: LONGMANS, GREEN, and Co., Paternoster Row.

THE CHEMICAL NEWS.

VOL. XXVIII. No. 720.

(STUDENTS' NUMBER.)

SCIENCE IN THE UNIVERSITIES.

THE Third Report of the Commission on Scientific Instruction and the Advancement of Science relates exclusively to the Universities of Oxford and Cambridge. The Commissioners at the outset of their report draw a necessary distinction between Science as limited by the scope of the duties assigned them, and "the mental and moral sciences, as well as those parts of human knowledge and culture which are not usually regarded as having any scientific character."

The report is too voluminous, and the subjects to which it relates are too important, to permit of our dealing with all the matters considered in it. We select, therefore, those which, in our opinion, are of primary importance.

It will not surprise those who have seen the previous reports of the Commission to hear, that, in considering what may be regarded as the connecting link between school and college careers, the Commissioners expressing a preference for an examination at leaving school to college matriculation examinations, insist strongly on the importance, for the future, of scientific education in England; that, in case such an examination should be instituted, those parts of science which are suitable for the education of boys should be recognised in it. Passing thence to the question of the university curriculum, they present the arguments for and against the desirability of insisting on a certain amount of literary culture in the case of scientific students. The Commissioners, while expressing their opinion that some evidence of literary culture should be required by the University from every student, urge that the principle should be extended, and that, "in like manner, evidence of corresponding scientific culture should be required from the student of classical literature or of theology." It is urged, however, that the student of any special department should be freed at an early period of his university career from any obligatory subjects of study.

Passing over the suggestion that scholarships should be founded in natural science, we come to an extremely important part of the report—the discussion, namely, of the existing arrangements for science teaching at the two universities. We notice, with strong approval, that, in passing, the Commissioners draw attention to the possible mischief resulting from the influence of the competitive mathematical examination at Cambridge. "It does not seem probable," they justly notice, "considering the keenness of the competition for high places in the mathematical tripos, that students would be willing to interrupt their more direct preparation for examination by attending numerous courses of professors' lectures." The Commissioners evidence also the existing state of the scientific institutions at the two universities, and although they do not

express absolute dissatisfaction, they indicate their opinion that our universities fall short of the standard of excellence attained elsewhere.

But perhaps the most noteworthy, as it is certainly the most critical (we do not say questionable) proposition in the whole report, is contained in the following paragraph:—

"It is, in our opinion, most important that a certain number of fellowships should be appropriated to the direct promotion of learning and research in various directions. It has been objected to this proposal that the fellowship system, as hitherto administered, has not shown any great tendency to encourage original research, either in the field of learning or in that of science; that when an office is created simply and solely with the view of giving a man leisure for original research, there is always the appearance, to say the least, of creating a sinecure; and that it is impossible, as Professor Jowett has said, to get a man for money who can make a discovery. But, though you cannot get a man for money to make a discovery, you may enable a man who has shown a special capacity for research to exert his powers; and we are of opinion that, unless an effort is made to do this, one of the great purposes for which learned bodies, such as the colleges, exist, may run the risk of being wholly lost sight of." The Commissioners do not state what this purpose is, nor are we aware of any purpose, legitimately included in the general object for which colleges have been founded, which can be said to call for the foundation of research fellowships. It may be highly desirable that such fellowships should be established, and convenient that a portion of the wealth of our colleges should be applied to the promotion of original research; but it can scarcely be said that, when the colleges were first established, any such purpose was in view. "Scientific discoveries," proceed the Commissioners, "rarely bring any direct profit to their authors, nor is it desirable that original investigation should be undertaken with a view to immediate pecuniary results." Research, as Lord Salisbury has observed "is unremunerative; it is highly desirable for the community that it should be pursued; and therefore the community must be content that funds should be set aside to be given, without any immediate and calculable return in work, to those by whom the research is to be pursued." It may be that properly qualified candidates for such scientific offices would not at first be numerous, but we believe that, eventually, a considerable number of fellowships might be advantageously devoted to the encouragement of original research.

We must confess to some feeling of anxiety as to these suggestions. As an abstract proposition, it appears reasonable enough to assert that scientific workers should be helped in the manner indicated. But certain recent events have made it but too manifest that, so soon as a scheme for such a purpose comes to be definitely propounded, the men who will show in front among the claimants for this species of assistance will not be the really earnest workers in science, but the scientific Micawbers, who work at science under the continual hope that "something will turn up" for their own special advantage. Proposals savouring of self-interest have already shown what might be expected if ever any wide scheme for the appropriation of college funds to scientific research were set on foot. Any

mischievous wrought in this way, any circumstance by which the name of science would be brought into contempt, would be almost irreparable, especially as occurring just at the outset of the new arrangements by which it is hoped that, ere long, the real interests of science will be notably advanced.

With this exception, the report before us is, in our judgment, eminently satisfactory. There can be no question that the relations of our universities to science are at present not all that could be desired, and that they admit of ready improvement. The suggestions offered to this end by the Commissioners are reasonable and moderate; there is nothing in them to offend what may be called university susceptibilities, although they are not all such as the thorough going university man would accept. The mere fact, however, that not a few among the suggested alterations have come from and have had the support of men high in position in our universities, shows that the interests of these bodies have not been lightly regarded. We have very little doubt that good results will follow from the labours of the Commissioners; and if we have found reason to criticise one feature of their report, it is only because we would desire to see removed all risk that jobbery might one day become an element in the election to university fellowships, and that thus the interests of science would suffer instead of being advanced by the proposed arrangement.

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The French or the German Language—

At the option of the Candidate.‡

* The Classical Subjects for 1874 are—For January, 1874.—*Homor*, Iliad, Book xiv.; *Cicero*, De Senectute, and the Third Catilinarian Oratio. For June, 1874.—*Xenophon*, Anabasis, Book v.; *Virgil*, Georgics, Book iv., and *Æneid*, Book vi.

† Special stress is laid on accuracy in the Answers to the Questions in Greek and Latin Grammar.

‡ At the next Matriculation Examinations (January, 1874; June, 1874; and January, 1875) credit will be given to Candidates for Greek in addition to either French or German.

The Papers in French and German shall contain passages for translation into English, and questions in Grammar (limited to the Accidence) on subjects furnished by those passages.

Candidates shall not be approved by the Examiners unless they have shown a competent knowledge in each of the following subjects:—

1. The Latin Language, with Grammar, History, and Geography.
2. Either the Greek Language, with questions in Grammar, History, and Geography; or the French or the German Language, with questions in Grammar.
3. The English Language, English History, and Modern Geography.
4. Mathematics.
5. Natural Philosophy.
6. Chemistry.

BACHELOR OF SCIENCE. (B.Sc.)

This degree is conferred on candidates who pass a satisfactory examination in Mathematics, Mechanical and Natural Philosophy, Botany, and Vegetable Physiology, Zoology, and Chemistry.

FIRST B.Sc. EXAMINATION.

No candidate (with the exception of such as have obtained Honours at the Matriculation Examination in the preceding January) is admitted to this examination within one academic year of the time of his passing the Matriculation Examination.

The Fee for this Examination is £5.

The examination will commence on the third Monday in July. It is conducted by means of printed papers; but the Examiners are not precluded from putting, for the purpose of ascertaining the competence of the candidates to pass, *visa voce* questions to any Candidate in the subjects in which they are appointed to examine.

The First Examination includes the following subjects:—

NATURAL PHILOSOPHY.

Heat—

Sources of Heat; conduction—convection.

Effects of Heat: expansion generally—of water—of gases and vapours; liquefaction; vaporisation; latent heat; expansive form of steam; dew-point; gases and vapours compared.

Specific Heat.

Thermometers; Pyrometers.

Heat in the Radiant state.

Electricity—

Sources of Electricity.

Static Electricity; dual character—insulation—induction—specific inductive capacity—equivalent antithetic states

—disruptive discharge—convection; Electroscopes—Leyden Jar, &c.

Dynamic Electricity; Conduction—the electric current

—derived currents—induction of currents; Voltaic Pile and other voltaic arrangements.

Thermo-Electricity; Electro-Thermometer.

Magnetism—

Magnets, the Earth, &c.; Induction—communication—retention—Magnetic relations of iron, steel, &c.

Electro-Magnetism—as in the spark—in conducting media—in soft iron; Magneto-Electricity; principle of Electro-magnetic and Magneto-Electric machines.

Terrestrial Magnetism.

INORGANIC CHEMISTRY.

Matter; simple and compound.

Elementary bodies classed. Metallic and Non-Metallic bodies.

Chemical combination and Mechanical Mixture. Solution.

Outlines of Crystallography. Isomorphism. Dimorphism. Allotropic conditions of matter. Chemical Affinity. Laws of Combination by weight and by volume, as deduced from the history of the individual elements. Equivalent

Numbers. Equivalent Volumes. Symbolical Notation, including questions on the Unitary System. Formulæ. Nomenclature.

Chemical actions produced under the influence of Heat. Nature of Combustion. Structures and Properties of Flame. Principles of Illumination. Chemical action of Light. Photography.

Oxygen. Ozone.

Hydrogen. Water.

Nitrogen. Chemical constitution of the Atmosphere.

Diffusion of Gases. The Oxides of Nitrogen; Nitric Acid.

Ammonia.

Chlorine, Bromine, and Iodine. Their compounds with

Oxygen and Hydrogen. Theory of Bleaching.

Fluorine and Hydrofluoric Acid.

Sulphur, Sulphurous Acid. Manufacture and Chemical

applications of Sulphuric Acid. Other Oxygen compounds

of Sulphur. Sulphuretted Hydrogen.

Phosphorus. Oxygen and Hydrogen compounds of Phosphorus. Theory of Acids. Monobasic, Dibasic, and Tribasic Acids.

Carbon. Carbonic Oxide and Carbonic Acid. The principal Hydrogen compounds of Carbon. Manufacture of Coal Gas.

Silicon and Boron. Their compounds with the elements previously enumerated.

Metals. Characters of Metals as a class. Metallurgical Processes. Alloys. Classification of the Metals.

Potassium. Nitre. Gunpowder. Theory of the action of Gunpowder.

Sodium. Manufacture of Carbonate of Soda.

Barium, Strontium, Calcium. Mortars. Cements.

Magnesium. Aluminum. Glass. Porcelain.

Manganese. Iron. Composition and properties of Cast-

Iron, Wrought-iron, and Steel. Chromium.

Cobalt. Nickel. Zinc. Cadmium.

Lead. Manufacture of White-Lead.

Copper. Mercury. Bismuth. Tin. Arsenic. Antimony.

Silver. Gold. Platinum.

Principal compounds of the Metals with the Non-Metallic Elements. Theory of Salts.

Principles of Mineral Analysis.

Principles of Electro-Chemistry.

For the First Examinations, a knowledge of Inorganic Chemistry only is necessary.

EXAMINATION FOR HONOURS.

Candidates for Honours in Chemistry are examined in any of the following subjects, at the option of the Examiners:—

Elementary Substances and their combinations.

Electro-Chemistry.

Radiant Chemical Action.

In the Examination for Honours, the Candidate, being not more than twenty-two years of age, who most distinguishes himself in Chemistry and Natural Philosophy, will receive an Exhibition of Forty pounds per annum for the next two years.

SECOND B.Sc. EXAMINATION.

This Examination commences on the fourth Monday in October. Candidates for this Examination who have not previously taken the degree of B.A. are required either to have passed the First B.Sc. Examination at least one Academic year previously, or to have passed the First M.B. Examination in this University.

The Fee for this Examination is £5.

This Examination embraces Organic Chemistry, including the following subjects:—

Ultimate Analysis of Organic Bodies. Calculation of Empirical Formulæ. Methods of controlling Empirical Formulæ. Determination of the Equivalents of organic acids and bases; examination of products of Decomposition; determination of the Vapour-Density of volatile bodies.

Law of Substitution. Compound Radicals. Homologous Series.

The Chemical History of the Cyanogen group. Cyanogen. Hydrocyanic Acid. Cyanic Acid and Urea. Fulminates. Sulfuric Acid. Sulphocyanic Acid. Chlorides of Cyanogen. Uric Acid.

Amylaceous and Saccharine Substances. Fermentation. Alcohol, Wine, Beer, Bread, &c.

Homologues of Alcohol. Ethers, simple and mixed. Oxidation of Alcohol. Aldehyd and Acetic Acid, and their homologues. Anhydrides, simple and mixed. Compound Ethers.

Diatom Alcohols and their Acids. Glycol and Oxalic Acid and their homologues.

Triatomic Alcohols. Glycerin. Fatty and Oily bodies. Saponification.

Vegetable Acids;—the principal.

Ammonia and its Derivatives. Ammonium and Ammoniacal Salts. Amides and Amines: their Classification. The chief Natural Organic Bases.

Colouring Matters. Indigo and its derivatives. Principles of Dyeing.

The chief constituents of the Vegetable organism. Cellulose, Vegetable Fibrin, Albumen, Casein, Glutin, &c.

The chief constituents of the Animal organism. Animal Fibrin, Albumen, Casein, Gelatin. Blood, Milk, Bile, Urine, &c.

Decay, Putrefaction. Destructive Distillation.

The Chemical Principles of the process of Nutrition and of Respiration in Plants and Animals.

EXAMINATION FOR HONOURS.

The Candidate, not more than twenty-three years of age, who, in the Examination for Honours, most distinguishes himself in Chemistry, will receive Fifty pounds per annum for the next two years, with the style of University Scholar.

DOCTOR OF SCIENCE (D.Sc.).

This Examination is held within the first twenty-one days of June, and occupies four days.

No Candidate is admitted to the Examination for the Degree of D.Sc. until after the expiration of two Academic years from the time of his obtaining the Degree of B.Sc. in this University.

Candidates for the Degree of D.Sc. in any year, must give notice of their intention to the Registrar, and pay to him a Fee of Ten pounds, on or before the 1st of April.

Chemical Candidates can be examined either in Inorganic or Organic Chemistry; but no Candidate will be approved by the Examiners unless he has shown a thorough practical knowledge* of the Principal Subject, and a general acquaintance with the *Subsidiary Subject*, or *Subjects*, specified as belonging to the Branch so selected.

Inorganic Chemistry.

Principal Subject—Inorganic Chemistry.

Subsidiary Subjects—Either Organic Chemistry; or, Mineralogy, Crystallography, and Chemical Technology in its relations to Inorganic Chemistry.

Organic Chemistry.

Principal Subject—Organic Chemistry.

Subsidiary Subjects—Either Inorganic Chemistry; or, Chemical Technology, in its relations to Organic Chemistry, and the Chemistry of Animal and Vegetable Life.

THE EXAMINATIONS FOR WOMEN.

The standard of attainment expected at the General Examination is the same as that expected in the corresponding subjects at the Matriculation Examination; and the standard of attainment expected at the Special Examinations is the same as that expected at those Examinations for the B.A. and B.Sc. Degrees, of which the programmes correspond.

* It must be understood that the Candidate for the Degree of D.Sc. is expected to be so fully conversant with the principal subject he may select, as to be able to go through any examinations test (whether theoretical or practical) of his acquirements in it that can be fairly applied.

In order that the requisite arrangements may be made, it is expected that intending Candidates will give notice of the optional subjects they select (where liberty of choice is allowed) not later than the 15th of March in each year.

GENERAL EXAMINATION.

The General Examination is held once in each year, and commences on the first Monday in May.

No Candidate is admitted to this Examination unless she has produced a Certificate showing that she has completed her seventeenth year. This Certificate must be transmitted to the Registrar at least *fourteen days* before the commencement of the Examination.

No Candidate is admitted to this Examination unless she has previously paid a Fee of Two Pounds to the Registrar. If a Candidate withdraw or fail to pass the Examination, the Fee is not returned to her, but she is admissible to any *two* subsequent General Examinations without the payment of any additional Fee, provided that she give notice to the Registrar at least *fourteen days* before the commencement of the Examination.

The Examination is conducted by means of printed papers; but the Examiners are not precluded from putting, for the purpose of ascertaining the competence of the Candidates to pass, *viva voce* questions to any Candidate in the subjects in which they are appointed to examine.

Candidates are not approved by the Examiners unless they have shown a competent knowledge in each of the following subjects:—

1. Latin, with Grammar, History, and Geography.
2. Any two of the following Languages:—Greek, French, German, Italian.
3. English Language, English History, and Geography (Physical and Topographical).
4. Mathematics.
5. Natural Philosophy.
6. Either Chemistry or Botany.

CERTIFICATES OF HIGHER PROFICIENCY.

Any Candidate who has passed the General Examination may be examined for a Special Certificate of Higher Proficiency in any one or more of the following subjects, either in the same year or in different years, provided that she give notice of her intention two calendar months before the commencement of the General Examination:—Latin, Greek, French, German, Italian, English, Mathematics and Mechanical Philosophy, Natural Philosophy and Chemistry, Botany, Human Physiology, Geology and Palaeontology, Political Economy, Logic and Moral Philosophy, Harmony and Counterpoint.

The Examinations for these Certificates will commence on the day immediately following the third Monday in May.

CHEMICAL LECTURES AND LABORATORY INSTRUCTION.

UNIVERSITY COLLEGE.

FACULTY OF SCIENCE.

Dean.—Professor J. B. Sanderson, M.D., F.R.S.

Vice-Dean.—Professor A. W. Williamson, Ph.D., F.R.S.

The Session begins on Thursday, the 2nd of October, and ends about the end of June.

It is divided into three Terms, as follows:—Michaelmas term, from October 2nd until December 20th; Lent term, from January 7th, 1874, till March 18th; Summer term, for Lectures, from March 19th till June 9th, all inclusive.

Chemistry.—Professor Williamson, Ph.D., F.R.S.

Assistant Professor.—Charles Graham, D.Sc.

A. GENERAL COURSE.

Lectures daily, except Saturday, from 11 to 12 a.m., &c. to the last week in March.

Exercises on Tuesdays, Wednesdays, Thursdays, and Fridays, from 9 to 2 a.m.

Fee for the Whole Course of Lectures, £7 7s.; for the First or Second Half Course, separately £4 4s.; for the Second Half when the First has been taken, £3 3s.; Perpetual, £9 9s.; for the Organic Course alone, £2 2s.

Fee for the Exercise-Class—For the Course, £2 2s.; for the Half Course, £1 1s.

The Instruction in this Class is of two kinds, consisting partly of Experimental Lectures by the Professor, partly of exercises and personal instruction on the subject of the Lectures by the Assistant Professor.

Students cannot profit duly by attendance on the Lectures, unless they work at the subject of each Lecture so as to make it their own.

Attendance on the tutorial part of the Class enables Students to do their work more effectually and rapidly than they can do it by themselves.

The First Half of the Course to Christmas includes those parts of Chemistry which are required for the Matriculation Examination of the University of London.

The Second Half of the Course, from January to March, includes the following subjects:—

Preparation and properties of the chief metals, including their characteristic reactions and most important salts. Detection of Metallic Poisons. Quantitative Estimation of Metals. Principles of Classification. Monatomic, Diatomic Metals, &c.

A weekly *visa voce* examination is held during the First Half Course and the commencement of the second Half Course.

Organic Chemistry.

This commences in the second week in February, and occupies Five Lectures weekly till about the end of March. It includes a study of the characteristics and metamorphoses of the chief organic acids, bases, alcohols, ethers, colouring matters, &c. Methods of ultimate and proximate analysis. Determination of molecular weights. Theory of types; of compound radicals. Phenomena of fermentation, &c.

Teachers of Chemistry are trained in the theory and practice of their profession. A two years' Course is absolutely requisite for this purpose; but Students will with advantage devote a longer period to it.

The first year is occupied with attendance on the Courses of Chemistry and of Analytical Chemistry. In the second year the Student again attends the Course of Chemistry, and is entrusted with teaching work in conjunction with the tutors of the Class. At the same time he continues to work in the Laboratory at analysis and original research.

In order to qualify themselves for rising to the higher ranks of the Profession, gentlemen remain for a further period, in which case they may obtain remunerative work in teaching through the recommendation of the Professor.

It must not, however, be supposed that a study of Chemistry alone, however complete, is sufficient to qualify a man to teach the Science effectually. A competent knowledge of Physics, Mathematics, and either French or German must necessarily be acquired at some period of his Student's Course.

B. ANALYTICAL AND PRACTICAL CHEMISTRY.

I. BIRCKBECK LABORATORY.

The instruction in the Laboratory is intended for beginners as well as for more advanced students. It includes practice in the construction and use of apparatus for preparing the common gases, acids, bases, salts, &c.; study of the qualitative methods of detecting and separating mineral or organic bodies from one another; also quantitative analysis in the wet way, organic analysis, vapour densities, &c.; instruction in gas analysis.

More advanced Students are instructed in the methods of original research, especially in organic chemistry.

When accompanied or preceded by attendance on the Lectures on Chemistry, the Laboratory Course qualifies

Students in the application of Chemistry to the Manufacturing Arts, Metallurgy, Medicine, or Agriculture, &c. Instruction is given in the principles and processes of Gas Analysis.

The Laboratory and Offices are fitted up completely with the most improved apparatus and utensils for experimental research, both for beginners and for advanced Students. They are open daily, from 9 a.m. to 4 p.m., from the 4th of October until the end of July, with a short recess at Christmas and at Easter. Saturday, from 9 to 2.

Fees for the Session, 25 guineas; six months, 18 guineas; three months, 10 guineas; one month, 4 guineas; exclusive of the expense of materials. A deduction of about 40 per cent is made for Students who can attend only three fixed days per week.

A Gold Medal and Certificates of Honour are competed for by Students entered for the Session.

II. SUMMER COURSES.

1. Elementary Course.

About Forty Lessons, of one hour each, on Tuesday, Wednesday, Thursday, and Friday, from 11 to 12, commencing in the first week of May. Students are taught the construction and use of apparatus for the preparation of the most important gases, acids, &c. The characteristic tests for the presence of the common acids and bases, including the chief metallic and other poisons. Also the processes for separating these bodies from one another.

Solutions are frequently given in the class for investigation.

The first six weeks of the Course are occupied by the study of the chief non-metallic elements, and their simple compounds. Metallic salts, &c., are subsequently studied.

Fee, including the cost of materials and apparatus, for the Course, £4 4s.; Perpetual, £7 7s.

II. Senior Course.

This Course consists of Twenty Lessons, of two hours each, on Mondays and Saturdays, from 10 to 12, commencing in the first week in May.

The First Half of the Course includes tests for fixed and volatile organic acids, nitrogenised acids, sugars, glycerin, alkaloids, &c.

The Second Half of the Course includes tests for mineral poisons in organic mixtures; also tests for organic bodies, such as the alkaloids, when mixed with other organic substances.

Volumetric methods of the quantitative analysis of sugar and urea, chlorides, phosphates, hardness of water, alkalimetry, are practised.

Analyses of milk and of ashes of blood.
Fee, including cost of materials and apparatus, for the Course, £4 4s.; Perpetual, £7 7s.

C. SUMMER MATRICULATION COURSE.

Professor Williamson, F.R.S.

Assistant Professor,—Charles Graham, D.Sc.

This Course includes those parts of Chemistry which are required for the Matriculation Examination of the University of London.

The Course consists of about Twenty Lessons in Practical Chemistry, and of an equal number of Oral Lessons. The Practical Lessons include the preparation of the common gases and acids, &c., and the study of their characteristic properties in relation to the elementary laws of combination.

The other Lessons are chiefly devoted to those parts of the subject which require fuller oral explanation than is given in the Practical Lessons. They include numerous exercises and questions, to which answers in writing are given by the Students. These Lessons will begin on Tuesday, April 14, 1874, at 11 a.m.

The Class will meet on Tuesdays, Wednesdays, Thursdays, and Fridays, from 11 to 12; and some other meetings will be announced when the Class has assembled.

Fee, including cost of materials and apparatus, £4 4s.

SCIENCE AND ART DEPARTMENT OF THE
COMMITTEE OF COUNCIL ON EDUCATION,
SOUTH KENSINGTON,
AND

ROYAL SCHOOL OF MINES, JERMYN STREET.

The Lords of the Committee of Council on Education having transferred the instruction in Physics, Chemistry, Applied Mechanics, and Natural History, from the Royal School of Mines, in Jermyn Street, and the College of Chemistry, in Oxford Street, to the New Buildings, in Exhibition Road, South Kensington, the following Courses of Lectures, Demonstrations, and Practical Laboratory instruction are now given at South Kensington at the dates specified:—

Chemistry, by Professor Frankland, D.C.L., F.R.S. A Course of Forty Lectures on Inorganic Chemistry, commencing October 6, 1873. A Course of Thirty Lectures on Organic Chemistry, commencing January 19, 1874. Laboratory instruction, consisting of an elementary and an advanced Course, commencing on October 1. Fees—Lectures on Inorganic Chemistry, £4; Lectures on Organic Chemistry, £3; together, £6. Laboratory instruction—£12 for three months, £9 for two months, and £5 for one month.

Biology, by Professor Huxley, LL.D., F.R.S. A Course of Eighty Lectures on Biology (or Natural History, including Palæontology), with Laboratory instruction, commencing October 6, 1873. Fee for the full Course, £10—For the Lectures only, £4; for the Laboratory instruction, £6.

Physics, by Professor Frederick Guthrie. The Course will consist of about Sixty Lectures, with Laboratory work on the subject of the Lectures. The Course will commence on February 16, 1874. Fee for Lectures alone, £4; fee for Lectures and Laboratory work, £10.

Applied Mechanics, by Professor Goodeve, M.A. The Course will consist of Thirty-Six Lectures, with Demonstrations, commencing on February 16, 1874. Fee for the Course, £4.

Besides the Students entering for the Associateship of the Royal School of Mines, and Teachers in Training, only such a limited number of occasional public Students will be admitted as can be accommodated. Letters with respect to the foregoing Courses should be addressed to the Secretary, Science and Art Department, South Kensington, London, S.W.

The instruction in Chemical Science embraces:—

(1). A Course of Lectures on Experimental Chemistry, with special reference to the applications of Chemistry in the Arts and Manufactures.

(2). A systematic Laboratory Course for the Practice of Chemical Analysis.

(3). An advanced Laboratory Course for technical applications of Chemical Analysis and for Chemical Research.

Chemical Laboratories.—The Laboratories for instruction in chemical manipulation, in qualitative and quantitative analysis, the technical application of analysis, and in the method of performing chemical researches, are under the direction of Dr. Frankland, and will be opened on Wednesday, October 1, 1873. The Laboratories at South Kensington Museum are now used for the instruction of the pupils of the Royal School of Mines.

There are three terms in the collegiate year, of three months each, commencing in the first week of October, January, and April, respectively. The Laboratory hours are from 10 a.m. to 5 p.m., with the exception of Saturdays, when the Laboratory closes at 2 o'clock.

Each Laboratory Student works independently, there being no classes. All operations are superintended by the Professor and his assistants. A table with drawers, cupboards, and shelves is appropriated to every pupil. The Institution supplies gas, fuel, and reagents. The larger and more expensive instruments of the Laboratory, such as air-pumps, thermometers, barometers, condensers

&c., may be used by the Students, who are responsible for their safety. The Students have to provide themselves only with the apparatus specified in the Laboratory regulations. More advanced Students engaged in private researches have to supply themselves with such materials as are not included amongst the ordinary reagents of the Laboratory.

The charge for instruction in the Chemical Laboratory is £12 for three months, £9 for two months, and £5 for one month. This charge does not include the fees for attending the Lectures.

Professor of Metallurgy.—Dr. Percy, F.R.S.

The course of instruction in Metallurgy consists of Lectures and Laboratory Practice, especially in Assaying. The object of the Lectures is the communication of such instruction as the student may be able to apply to the greatest practical advantage when he may be subsequently engaged in conducting any metallurgical process.

Metallurgical Laboratory.—This Laboratory is conducted by Mr. R. Smith, under the direction of Dr. Percy, and is devoted to practical instruction in Metallurgy, especially in Assaying. The nature of this instruction will be adapted to the special requirements of the student. It comprises:—Assaying in all its branches, especially of the more important metals, such as iron, copper, lead, tin, alloys of silver and gold, &c.; and the examination of ores and metallurgical products.

The ability of the student to make trustworthy assays is in every case thoroughly tested; and no certificate of competency is given to a student who has not furnished satisfactory proof that he is able to obtain accurate results.

There are three terms in the collegiate year, of three months each. The Laboratory hours are from 10 to 4 during November, December, January, February; and from 10 to 5 during the other months, with the exception of Saturdays, when the Laboratory is closed.

The charge for instruction in the Metallurgical Laboratory is £15 for three months, £12 for two months, and £7 for one month.

Lectures to Working Men.—Short Courses of Lectures at suitable periods of the year are given in the evening to Working Men. These courses are systematic, and arranged so as to illustrate, within a period of two years, the principal subjects taught at the Institution. Those for the ensuing Session include Natural History, Geology, and Mineralogy.

EXAMINATIONS IN CONNECTION WITH THE
DEPARTMENT OF SCIENCE AND ART, SOUTH
KENSINGTON.

A sum of money is voted annually by Parliament for scientific instruction in the United Kingdom. The object of the grant being to promote instruction in Science, especially among the Industrial classes, by affording a limited and partial aid or stimulus towards the founding and maintenance of Science schools and classes.

The following are among the Sciences towards instruction in which aid is given:—Acoustics, Light, Heat, Magnetism, and Electricity, Inorganic Chemistry, Organic Chemistry, Geology, Mineralogy, Mining, Metallurgy.

The assistance granted by the Science and Art Department is in the form of:—1. Public Examinations, in which Queen's Medals and Queen's Prizes are awarded, held at all places on complying with certain conditions. 2. Payments on results to teachers. 3. Scholarships and Exhibitions. 4. Building Grants. 5. Grants towards the purchase of apparatus, &c.

KING'S COLLEGE.

Professor of Chemistry and Practical Chemistry.—C. L. Bloxam, F.C.S.

Demonstrator.—W. N. Hartley, F.C.S.

The Session commences on the 1st of October. Students of the first and second years are admitted to the Course of Theoretical and Applied Chemistry. The Course commences with a view of the forces which concur to

the production of Chemical Phenomena, after which the laws of Chemical Attraction are discussed, and the Non-Metallic Elements and their principal compounds are described.

The metals and their principal compounds are next examined, care being taken to point out the applications of the Science to the Arts, and the processes of the different Manufactures of Metallurgy, and of Domestic Economy, are explained and illustrated.

Examinations of the Class, both *visa voce* and by written papers, are held at intervals during the Course, at the usual Lecture hour.

Third Year.—Students who have completed six Terms in this Department are admitted to a Course of Practical Chemistry, consisting of Twelve Demonstrations in each term; and they go through a course of Manipulation in the most important operations of Chemistry, including the first steps of Analysis.

Any Student of this Department may be admitted to this Class at any period of his study, on payment of an extra fee.

Analytical and Experimental Chemistry.—Besides the Course of Chemical Lectures and the Summer Class of Practical Chemistry, provision is made for those Students who wish to become more minutely acquainted with the practical details of the Science. By means of this Class each Student is enabled to familiarise himself with the methods of analysis and research. After passing through a preliminary course of analytical operations, each Student devotes himself to such portions of the science as are most interesting to himself, or most likely to be practically useful to him. The Daniel Scholarship of £20, tenable for two years, is given every alternate year for original research in the Laboratory.

The Fees for admission to the Laboratory Class, exclusive of materials, are, for one month, £4 4s.; for three months, £10 10s.; for six months, £18 18s., &c.

EVENING CLASSES.

Classes for Evening Instruction are held at King's College from October to March, and during April, May, and June.

The Classes include one for the Elements of Chemistry and one for Practical Chemistry.

The fee for the former is £1 11s. 6d.; for the latter, £2 2s. The classes meet twice a week.

THE SCHOOL OF PHARMACY,

17, BLOOMSBURY SQUARE, W.C.

(IN CONNECTION WITH THE PHARMACEUTICAL SOCIETY.)

The Session commences on October 1st, and extends to the end of July.

LECTURES ON CHEMISTRY AND PHARMACY, BY DR. REDWOOD.

These Lectures will be delivered on Monday, Tuesday, and Wednesday mornings, at 9 o'clock.

Fees.—One Course, £2 2s. An entire Session—two Courses, £3 3s. Perpetual admission, £4 4s.

Also Lectures on Botany and Materia Medica, by Professor Bentley. The first and second parts of this course, extending over the winter months, will be delivered at 17, Bloomsbury Square, on Friday and Saturday mornings, at 9 a.m. The third part of the course, on Systematic Botany, will be delivered at the Royal Botanic Gardens, Regent's Park, at 8 a.m.

Fees.—Botany and Materia Medica, one Course, £1 11s. 6d.; two Courses, £2 12s. 6d. Systematic and Practical Botany, £1 1s. each Course. Sessional Fee for the three Courses, £3 3s.

Practical Chemistry.—The suite of Laboratories for Practical Instruction in General and Pharmaceutical Chemistry will be opened on October 1st, under the direction of Professor Attfield, F.R.S.

Demonstrator.—John Moss, F.C.S. Fee for the entire Session of ten months, Twenty-five Guineas. The Laboratories are open from 10 a.m. till 5 p.m. Students can enter at any period during the Session.

Two Scholarships (the Jacob Bell Memorial Scholarship) of Thirty Pounds a year each, are open to competition annually in July.

Students have free admission to the Library and Museum. CITY OF LONDON COLLEGE, LEADENHALL STREET, E.C.

The Annual Courses consist of three terms, each averaging ten Experimental Lectures. Fee, 5s. per term.

Subjects.—Junior Class, Chemistry—First year, Non-Metals; second year, Metals and (time permitting) Elements of Organic Chemistry. Senior Class, 7 to 8 p.m., Practical Analysis.

BIRKBECK LITERARY AND SCIENTIFIC INSTITUTION,

EVENING CLASSES.

Chemistry, Elementary.—Mr. G. Chaloner. Thirty Lectures. Tuesday, 7.30 to 8.30, commencing October 7. **Advanced.**—Tuesday, 9 to 10. Thirty Lectures.

Practical Chemistry and Analysis.—From 8 to 10, Saturday evenings, commencing October 11.

ROYAL POLYTECHNIC INSTITUTION,

309, REGENT STREET, W.

The Scientific Department is under the direction of Professor E. V. Gardner, F.R.S., F.S.A., who is assisted in his duties by gentlemen of known competency.

Instruction in classes is given in Chemistry, Electricity, Galvanism, Geology, Photography, &c. These and the various subjects required by the different Examining Boards are taught and thoroughly demonstrated. To this purpose the extensive School of Apparatus, as well as that employed for illustrating the Public Lectures, is made use of.

Private Courses of study can also be pursued under the direction of Professor Gardner, who has constructed Private Class Rooms and Laboratories.

Provision has been made for Ladies desirous of studying the Sciences.

The Patent Department is valuable to Inventors, as they can be provided with the necessary apparatus to pursue their enquiries, or they may have a full investigation conducted.

ROYAL VETERINARY COLLEGE, CAMDEN TOWN.

Chemical Professor.—Mr. R. V. Tuson.

BERNERS COLLEGE OF EXPERIMENTAL SCIENCE,

44, BERNERS STREET, W.

Under the direction of Professor E. V. Gardner, F.R.S., F.S.A.

The Class Rooms and Laboratories are open to private students, who can arrange to pursue any branch of study at their own convenience with the advantage of School of Apparatus for illustration and experiment.

The Classes during the Session embrace the subjects of Chemistry, Magnetism, Electricity, Galvanism, Geology, Photography, Botany, Steam, &c.

A Course of study is arranged to meet the requirements of gentlemen preparing for Matriculation, for the various Governmental Examinations and Examining Boards.

Analysis of manures and other substances and Assays are performed, and much attention is paid to original experiments and investigations connected with Patents and Inventions.

Mathematics.—The Classics, Modern Languages, and the branches of knowledge useful for a successful examination are in the hands of competent teachers.

NORTH LONDON SCHOOL OF CHEMISTRY AND PHARMACY,

54, KENTISH TOWN ROAD, N.W.

Conducted by Mr. J. C. Braithwaite.

The Session 1873-1874 commences on the 1st of

October, when the Laboratory will be open for Instruction in Practical Chemistry.

The Classes for Chemistry, Materia Medica, Botany, and Latin, meet at 8 p.m. Fee to either Class 10s. 6d. per month.

The Botanical Garden affords facilities to Students desirous of acquiring a practical knowledge of Botany. During the Season Botanical Excursions are made every Saturday at 10 a.m.

As each Pupil works independently, he can enter at any period to either Classes or Laboratory.

SOUTH LONDON SCHOOL OF CHEMISTRY, 325, KENNINGTON ROAD.

This School was re-opened on September 8th in a new building specially erected for and adapted to the study of Chemistry and its Allied Sciences. The subjects taught include Chemistry, Botany, Physics, Latin, Materia Medica, and Pharmacy, for fifty students. All apparatus and chemicals are provided for the students. There is also a special department for instruction in Food Analysis at the Central Public Laboratory, Kennington Cross, under the personal supervision of the Director, who has been appointed Public Analyst. The Chemical portion of the Course consists of Ten Months' Lectures on Inorganic and Organic Chemistry. The Lecturer is Dr. John Muter, F.C.S., and the hour is 10 a.m. daily. The Laboratory is open daily for practical instruction from 10 till 4. Secretary, Mr. W. Baxter.

LECTURES AT LONDON MEDICAL SCHOOLS.

ST. BARTHOLOMEW'S HOSPITAL & MEDICAL COLLEGE.

WINTER SESSION.

Lecturer.—Dr. W. J. Russell, F.R.S. Monday, Wednesday, and Friday, at 10 a.m. One course, £5 5s.

SUMMER SESSION.

Practical Chemistry.—Dr. W. J. Russell, F.R.S. Monday, Tuesday, and Friday, from 11 to 1. One course, £2 2s.

CHARING CROSS HOSPITAL AND COLLEGE.

WINTER SESSION.

Lecturer.—Mr. C. W. Heaton, F.C.S. *Demonstrator.*—T. Bolas, F.C.S. Monday, Thursday, and Friday, at 11. One session, £5 5s.

The Laboratory is open daily.

SUMMER SESSION.

Practical Chemistry.—Mr. Heaton, F.C.S. *Demonstrator.*—T. Bolas, F.C.S. Monday and Friday. One session, £2 2s.

Special Evening Classes. Advanced Chemistry, Tuesday and Thursday, at 7 p.m. Fee, £2 2s. per month.

ST. GEORGE'S HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. H. M. Noad, F.R.S. Tuesday, Thursday, and Saturday, at 11.30. One course, £6 6s.

SUMMER SESSION.

Practical Chemistry.—Dr. Noad, F.R.S. Monday, Wednesday, Thursday, Friday, at 10. One course, including the use of apparatus and materials, £4 4s.

GUY'S HOSPITAL.

WINTER SESSION.

Lecturers.—Dr. Debus, F.R.S., and Dr. Stevenson. Tuesday, Thursday, and Saturday, at 11. One course, £4 4s.

SUMMER SESSION.

Practical Chemistry.—Dr. Debus, F.R.S. Monday, Wednesday, and Friday, from 10 to 1. One course, £4 4s.

Practical Instruction is also given in the Laboratory by Drs. Debus and Stevenson during the Winter Session.

LONDON HOSPITAL.

Lectures on Chemistry.—Henry Letheby, M.B., and C. Meymott Tidy, M.B. Monday, Wednesday, and Friday, at 10.30 a.m. One session, £7 7s.

Practical Chemistry.—Dr. Letheby, M.B. Monday, Thursday, and Saturday, at 9 a.m. One session, £3 3s.

ST. MARY'S HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. C. R. A. Wright, F.C.S. Monday, Tuesday, Thursday, and Friday, at 9 a.m. £5 5s.

SUMMER SESSION.

Practical Chemistry.—Dr. C. R. A. Wright, F.C.S. *Inorganic Course.*—Arranged for the requirements of the London University Preliminary Scientific Examination. Tuesday, Friday, and Saturday, at 9 a.m. Fee, £3 3s.

Organic Course.—Arranged to meet the requirements of the London University First M.B. Examination. Tuesday and Friday at 10 a.m. £3 3s.

MIDDLESEX HOSPITAL.

WINTER SESSION.

Lecturer.—Mr. Heisch. Monday, Tuesday, Friday, and Saturday, at 11. One session, £6 6s.

SUMMER SESSION.

Practical Chemistry.—Mr. Heisch. Monday, Wednesday, and Friday, at 11. One session, £3 3s.

ST. THOMAS'S HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. A. J. Bernays. Wednesday, Thursday, and Friday, at 9. One course, £5 5s.

SUMMER SESSION.

Practical Chemistry.—Dr. A. J. Bernays. Tuesday and Thursday, 10 to 12; Friday, 11; Saturday, 10 to 1. One course, £3 3s.

WESTMINSTER HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. A. Dupré, F.C.S. Tuesday and Thursday, at 3 p.m.; Friday, at 10 a.m. One course, £5 5s.

SUMMER SESSION.

Practical Chemistry.—Dr. A. Dupré, F.C.S. Monday, Wednesday, and Friday, at 10 a.m. One course, £3 3s.

TEACHERS OF CHEMISTRY IN LONDON.

Mr. Henry Matthews, F.C.S.—Laboratory, 60, Gower Street, Bedford Square. Instruction in all branches of Practical Chemistry, particularly in its application to Medicine, Agriculture, and Commerce. Laboratory open daily, except Saturday, from 10 to 5; on Saturday, from 10 to 1.

Mr. John Newlands, F.C.S.—Laboratory, 13, Knowle Road, Brixton, S.W. Gives practical instruction in Analysis, and prepares gentlemen for various public examinations.

Mr. A. Vacher.—20, Great Marlborough Street, Regent Street.

UNIVERSITY OF OXFORD.

Professor of Chemistry.—Dr. Odling, F.R.S.

Demonstrator.—E. Madan, M.A.

A commodious Laboratory is attached to the New Museum.

Scholarships of about the value of £75 are obtainable at Christ Church, Magdalen, and other Colleges, by competitive examination in Natural Science.

UNIVERSITY OF CAMBRIDGE.

Professor of Chemistry.—G. D. Liveing, M.A.

Demonstrator.—J. W. Hicks, M.A.

LECTURES IN MICHAELMAS TERM.

Chemistry, general principles, by the Professor, on Mondays, Wednesdays, and Fridays, at 12.

Spectroscopic Analysis, by the Professor.
Practical Chemistry, by the Demonstrator, daily.
Organic Chemistry, by Mr. Main, at St. John's College.
Volumetric Analysis, by Mr. Apjohn, at Gonville and Caius College.

LECTURES IN LENT TERM.

Chemistry, general principles continued, by the Professor, on Mondays, Wednesdays, and Fridays, at 12.
Quantitative Analysis, by the Professor, same days, at 1.
Practical Chemistry, by the Demonstrator, daily.
Elementary Chemistry, by Mr. Main, at St. John's College.
Quantitative Analysis of rarer elements, by Mr. Apjohn, at Gonville and Caius College.

LECTURES IN EASTER TERM.

History of Chemical Philosophy, by the Professor, on Mondays, Wednesdays, and Fridays, at 12.
Quantitative Analysis, same days, at 3.
Elementary Inorganic Chemistry, by the Demonstrator.
Chemistry, continued, by Mr. Main, at St. John's College.
Organic Analysis, by Mr. Apjohn, Gonville and Caius College.

The Chemical Laboratory of the University is open daily from 10 a.m. until 6 p.m., for the use of students, under the direction of the Professor. The Demonstrator attends there daily to give instruction in manipulation, alternately in the morning and afternoon.

PROVINCIAL SCHOOLS.

BIRMINGHAM.—MIDLAND INSTITUTE.

Lecturer on Chemistry.—Mr. C. J. Woodward, B.Sc. Tuesday and Thursday, at 8 p.m.

Practical Chemistry.—Mr. C. J. Woodward, B.Sc. Saturday, 3 to 6, and 6.30 to 9.30 p.m.

BIRMINGHAM.—QUEEN'S COLLEGE.

WINTER SESSION.

Professor of Chemistry.—Alfred Hill, M.D., and A. G. Anderson. Tuesday, Thursday, and Friday, at 12.

SUMMER SESSION.

Practical Chemistry.—Professor A. G. Anderson. Thursday and Friday, at 2 p.m.

BRISTOL.—BRISTOL MEDICAL SCHOOL.

WINTER SESSION.

Lecturer.—Mr. Thomas Coomber, F.C.S. Monday, Tuesday, Wednesday, and Thursday, at 8.15. One Course, £5 5s.

SUMMER SESSION.

Practical Chemistry.—Mr. T. Coomber, F.C.S. Daily, except Saturday, at 8 a.m. One Course, £3 3s.

ROYAL AGRICULTURAL COLLEGE,
CIRENCESTER.

CHEMICAL DEPARTMENT.

Professor.—A. H. Church, M.A. Oxon.

Assistant.—R. C. Woodcock, F.C.S.

The Autumn Session commenced on the 13th of August; it divides on the 6th of October, and terminates about the 18th of December.

The Chemical instruction comprises Three Courses of Lectures and Laboratory Practice:—

- (1). 32 Lectures on Inorganic Chemistry.
- (2). 32 Lectures on Organic Chemistry.
- (3). 24 Lectures on Agricultural Chemistry.
- (4). 32 Lessons on Chemical Manipulation.
- (5). 32 Lessons on Qualitative Analysis.
- (6). 32 (or more) Lessons on Quantitative Analysis.

Catechetical Lectures are also given, while analyses of manure, oil-cakes, minerals, soils, waters, &c., are daily performed in the College Laboratories, and Chemo-Agricultural researches undertaken by the more advanced

Students, under the immediate direction of Professor Church.

The text-books used are Church's "Laboratory Guide," Roscoe's "Chemistry," and Church and Dyer's edition of "How Crops Grow."

LIVERPOOL ROYAL INFIRMARY SCHOOL OF
MEDICINE.

Lecturer on Chemistry and Toxicology.—Dr. J. Campbell Brown.

Course of 100 Lectures. Monday, Tuesday, Thursday, and Friday, at 10.15. £5 5s.

Technological and other non-Medical Students may take out any of the divisions separately.—Fee, £1 1s.; but no certificates will be given until the whole Course has been attended.

Practical Chemistry.—The new Laboratories will be open on November 1 for the reception of Students, when those who desire to prosecute Practical Chemistry, analysis, or original research, will be provided each with a separate working bench and cupboard, with tests, fuel, water, and gas. Fees, from £2 2s. to £10 10s. per quarter.

Summer Practical Chemistry Course.—Fee, £3 3s.

A Class for the Practical study of Organic Chemistry will be formed during either the Winter or Summer Session. Fee, £3 3s., including materials and apparatus.

Gentlemen who are not Students of the School are also admitted to the Laboratory and Lectures.

The Laboratory is open daily from 10 to 4 (except Saturday), for the study of Practical Chemistry, and for Analysis.

ANALYTICAL LABORATORY AND SCHOOL OF
TECHNICAL CHEMISTRY.

7 and 9, HACKIN'S HEY, LIVERPOOL.

Conducted by Mr. A. Norman Tate.

Hours of attendance, 9.30 a.m. to 5 p.m. (Saturdays, 9.30 a.m. to 1 p.m.). Pupils may enter at any time and for any term.

Fees.—Three months, £15 15s.; six months, £26 6s.; twelve months, £52 10s.

The Laboratory is also open from October to end of April two evenings per week for practical work.

Lectures one evening each week.

A separate working bench is provided for each Student, and he is also supplied with all ordinary chemicals, gas, fuel, and the more substantial portions of Laboratory apparatus, but must provide himself with test-tubes, beakers, and other apparatus of a fragile nature.

In addition to the ordinary chemical studies, the Course of instruction will, as far as possible, comprise all such studies as may be required for the successful prosecution of the particular branch or branches of Applied Chemistry in which the pupil is to engage; as, for example, in the case of one intended for manufacturing pursuits, he would study architectural and mechanical drawing, so far as is required for the preparation of plans, &c., of chemical apparatus and manufactories, the nature and use of building materials, and the scientific principles and practical rules involved in building and constructive operations, and other scientific and practical information required in the arrangement, construction, and management of chemical manufactories, and the application of Chemistry to industrial pursuits.

LIVERPOOL.—OPERATIVES' SCIENCE CLASSES.

(IN CONNECTION WITH THE GOVERNMENT DEPARTMENT OF SCIENCE AND ART, AND THE OPERATIVE TRADES' HALL, LIVERPOOL).

Chairman.—Mr. James Samuelson.

Secretary.—Mr. M. Fitzpatrick, 62, Seel Street.

Session extends from October 3, 1873, to end of April, 1874.

Classes meeting at 9, Hackin's Hey.—Lecture Class, Friday evenings, 7 to 8 p.m.; Laboratory Practice, Friday evenings, 8 to 10 p.m. Teacher, Mr. Norman Tate.

Class meeting at St. Mary's Schools, Kirkdale.—Lecture Class, Thursday evenings. Teacher, Mr. Gordon.

COLLEGE OF CHEMISTRY, LIVERPOOL.

Founder.—Dr. Muspratt, M.D., &c.

Principal.—Mr. Martin Murphy, F.C.S., Professor of Chemistry.

The Course of instruction given in the College of Chemistry comprises the teaching of Chemistry as a science, and the general application of chemical knowledge; also the teaching of the principles of those branches of physics which are allied with Chemistry, such as light, heat, electricity, &c.

Particular attention is devoted to instruction in the practice of systematic analytical operations, whereby Students will be enabled to determine accurately the general and proximate constituents of substances, and so arrive at a knowledge of their nature and properties.

Instruction in the application of chemical data to medicine and agriculture, and to the chemical and metallurgical operations, comprising Technology, will be given, to qualify Students for these avocations.

The Students will invariably be controlled and directed in their study and work by the Principal and competent assistants. Ample Laboratory accommodation is provided for Students, and such general appliances as will facilitate their progress in acquiring a knowledge of the specialties taught in the College.

The Students' Laboratories are open throughout the year. Hours of attendance—From 10 a.m. to 5 p.m. daily. Fees—10 guineas per quarter of three months, or 35 guineas per annum, payable in advance. Students provide all their own apparatus and books.

Medical and Pharmaceutical Students are admitted for one hour per day. Fee for three months, £2 2s.

A Course of Lectures will be delivered to the Students during the winter months. Evening Classes.

Certificates of attendance recognised by the University and Apothecaries' Hall of London, and Apothecaries' Hall of Ireland.

LEEDS SCHOOL OF MEDICINE.

WINTER SESSION.

Lecturer.—Mr. Thomas Fairley, F.C.S.

Daily, except Wednesday and Saturday, at 11 a.m. First Session, £4 4s. Second Session, £3 3s.

SUMMER SESSION.

Practical Chemistry.—Mr. Fairley, F.C.S.

Mondays and Tuesdays, 9.30 to 11. Each Course, £3 3s.

General Chemical Students.—The Laboratories are open daily, under the direction of Mr. Fairley, for the instruction of General Students in Chemical Manipulation, Technical Chemistry, and all branches of analysis; and also for the use of gentlemen wishing to pursue special chemical researches.

The fees, payable in advance to the Treasurer, are as follows:—For one month, £4 4s.; for two months, £7 7s.; for three months, £10 10s.; for four months, £13 13s.; for five months, £15 15s.; for six months, £17 17s.; for nine months, £21. Special fees will be charged to Students who do not wish to work every day in the week.

The Chemical Museum contains minerals, metallic ores and metals, rare chemical substances, and illustrations of the most important chemical manufactures in their different stages.

Curator.—Mr. Scattergood.

LEEDS MECHANICS' INSTITUTION AND LITERARY SOCIETY'S LABORATORY.

Chemical Classes and Laboratory for Instruction in Elementary, Practical, and Analytical Chemistry, commenced on Friday, September 26, at 8 p.m.

Lecturer.—Mr. George Ward, F.C.S., with Assistants.

HIGH HARROGATE COLLEGE, YORKSHIRE.

Professor of Chemistry.—Mr. W. G. Mason, F.C.S., Certificated Science Teacher.

MANCHESTER GRAMMAR SCHOOL.

CHEMICAL DEPARTMENT.

Professor.—Francis Jones.

Instruction is given in Inorganic Chemistry, Organic Chemistry, Metallurgy, and Analytical Chemistry. There is a lecture-room and second Laboratory, affording accommodation for seventy-two Students.

MANCHESTER ROYAL SCHOOL OF MEDICINE.

(INCORPORATED WITH OWENS COLLEGE).

Lecturer on Chemistry and Practical Chemistry.—Henry E. Roscoe, B.A., Ph.D., F.R.S.

The usual Course for the Medical Boards.

Pending the completion of Medical School Buildings, in immediate proximity to the new College, the School will be conducted as heretofore in the old premises, 10, Faulkner Street, with the exception of the following Courses, which will be given in the Owens College, Oxford Road:—Chemistry and Physiology, Systematic and Practical, in the Winter Session, and Botany and Practical Chemistry in the Summer Session.

OWEN'S COLLEGE, MANCHESTER.

Chemistry.—Professor H. E. Roscoe, B.A., Ph.D., F.R.S., F.C.S.

Senior Demonstrator.—Mr. C. Schorlemmer, F.R.S.

Junior Demonstrator and Assistant Lecturer.—Mr. W. Dittmar, F.R.S.E.

Assistant Demonstrators.—Mr. W. Carleton Williams and Mr. Harry Grimshaw.

Experimental Chemistry Lectures.—Monday, Tuesday, Wednesday, Thursday, and Friday, from 11.30 a.m. to 12.30 p.m., during Michaelmas and Lent Terms.

The instruction in Theoretical Chemistry is given by means (a) of Experimental Lectures and (b) of Tutorial classes. The former will be delivered by Professor Roscoe on the days above-named.

Inorganic Chemistry.—Comprising (1) the laws of Chemical Combination; (2) A description of the Physical and Chemical properties, and the mode of preparation of the Non-Metallic Elements and of their compounds; (3) The Chemistry of the Metals and of their most important compounds.

Organic Chemistry.—Giving the composition and relations of the best defined groups of organic bodies and the laws regulating their formation.

The Tutorial Classes, conducted by Mr. Dittmar, will meet for recapitulation and for the correction of the written exercises, given out in the lectures during Michaelmas and Lent Terms, as follows:—1. Junior Tutorial. For First Year's students and those preparing for Matriculation, on Wednesdays, from 1.30 to 2.30 p.m. 2. Senior Tutorial. For Second Year's students and those preparing for the Science Degrees, on Saturdays, from 11.30 a.m. to 12.30 p.m. 3. Medical Tutorial. Specially adapted to the requirements of Medical students, on Fridays, from 12.30 to 1.30 p.m.

Regular students in the First Year's Arts and Science courses will be entitled to attend during the Michaelmas Term only, in the Second Year's Science and Engineering courses during both Terms.

Fee, for the complete course, £4 14s. 6d.; for either half, £2 12s. 6d.

Technological Chemistry.—Wednesday, from 2.30 to 3.30 p.m.

The chemical principles involved in the most important Chemical Manufactures will chiefly be considered in this course. The subject will be discussed as follows:—

1. Ten lectures on the Modes of Producing and Utilising Heat and Light, by Mr. Dittmar.

2. Ten lectures on Water and Air and the Chemistry of the Alkali Manufacture, by Professor Roscoe.

3. Ten lectures on the Chemistry of Colouring Matter, Dyeing, and Calico Printing, by Mr. Schorlemmer.

Students attending this class must be acquainted with the principles of chemical science.
Fee, £1 11s. 6d.

Organic Chemistry.—Lecturer, Mr. C. Schorlemmer, F.R.S., Tuesday and Thursday, from 2.30 to 3.30 p.m., and Friday, from 3.30 to 4.30 p.m.

The subject of this course is the Chemistry of the Carbon Compounds, wherein the branch of Organic Chemistry is more fully and completely treated than in the general course in Experimental Chemistry.

Fee, £3 10s.

Chemical Philosophy.—Lecturer, Mr. C. Schorlemmer, F.R.S., Saturday, from 9.30 to 10.30 a.m.

Sketch of the History of Chemistry; Development of Modern Chemistry; Chemical Laws and Theories; Relation of Chemistry to Physics.

Fee, £1 11s. 6d.

Lecture Class Analytical Chemistry.—Mr. W. Dittmar, F.R.S.E., Tuesday, from 4.30 to 5.30 p.m.

This course will treat of the methods of Qualitative and Quantitative Analysis, and is intended to supplement the instruction in Practical Chemistry.

All first year's Laboratory students are required to attend, and to answer the written exercises and the viva voce questions given in this class.

Fee, £1 11s. 6d.

Analytical and Practical Chemistry.

LABORATORY CLASS.

The aim of this course is to make the student practically acquainted with chemical science, to enable him to conduct analysis and original research, and to fit him for applying the science to the higher branches of Art, Manufactures, and Agriculture. To accomplish this, an attendance of not less than four days per week during three whole sessions is as a rule necessary. It is very advisable that each Laboratory student should attend, or should have attended, the course of Lectures on Theoretical Chemistry; and it is also recommended that second year's Laboratory students should attend one of the classes in Practical Physics.

The College Laboratory will be open for students daily from 9.30 a.m. until 4.30 p.m., except on Saturdays, when it will be closed at 12.30. The Laboratory is fitted with every convenience for the prosecution of Practical Chemistry, all branches of Qualitative and Quantitative Analysis, and original Research. Each student is provided with a separate working table, a set of tests, fuel, water, and gas, free of expense; but he is required to find his own apparatus, a few of the more expensive reagents, and the chemicals required for his experiments. Other apparatus or instruments of a more expensive description may be obtained on loan from the Laboratory Steward, subject to regulations to be prescribed by the Professor.

Fees for the Session.—For six days per week, £21; for four days per week, £17 17s.; for three days per week, £13 13s.; for two days per week, £9 9s.; for one day per week, £5 5s.

Students entering the Laboratory class at or after Christmas will be charged two-thirds of the fees for the whole session.

Fees for Shorter Periods.—For six days per week: For six months, £17 17s.; for five months, £15 15s.; for four months, £13 13s.; for three months, £10 10s.; for two months, £7 7s.; for one month, £4 4s.

The Lectures on Chemistry in Owen's College are recognised by the University of London for its Medical Degrees, by the Royal College of Surgeons, and by the Apothecaries' Hall.

EVENING CLASSES. Chemistry.

First Lecture Course.—(The Non-Metallic Elements).—Professor Roscoe. Monday, from 8.30 to 9.35 p.m.

Second Lecture Course.—(The Metals).—Mr. Carnelly. Friday, from 8.35 to 9.35 p.m.

Third Lecture Course.—(Organic Chemistry).—Mr. Schorlemmer. Thursday, from 8.35 to 9.35 p.m.

Laboratory Courses.—Professor Roscoe and Mr. Dittmar. Monday, from 6 to 8.30 p.m.

COLLEGE OF PHYSICAL SCIENCE, NEWCASTLE.

(IN CONNECTION WITH THE UNIVERSITY OF DURHAM).

Professor of Chemistry.—A. Freire-Marreco, M.A.

Demonstrator.—E. Haigh.

Junior Division—General Principles of Chemistry History of the Non-Metallic Elements.

History of the Metals and their more important compounds; Principles of Qualitative Analysis, Monday, Wednesday, and Friday, at 11 a.m.

Senior Division—Elements of Organic Chemistry. Tuesdays, at 11 a.m. Applied Chemistry, Thursdays, at 11 a.m. Fee, £5 5s.

Practical Chemistry.—The Laboratory is open from 10 a.m. to 1 p.m., and from 2 to 5 p.m., except on Saturday, when it closes at 1 p.m.

Laboratory Fees.—Students working six days per week, five guineas per term. Students working alternate days, three guineas per term. Students working one day per week, one guinea per term.

Evening Classes.—Prof. A. Freire-Marreco, M.A., Twenty Lectures on Inorganic Chemistry, Mondays, at 7.45, commencing October 20, 1873.

BOROUGH ANALYST'S LABORATORY, 1 and 3, SURREY STREET, SHEFFIELD.

Mr. A. H. Allen, F.C.S., delivers a Course of Thirty Lectures on Inorganic Chemistry and Metallurgy. Day and Evening Classes for the practice of Analytical Chemistry and Assaying.

SHEFFIELD SCHOOL OF MEDICINE.

A Course of Forty-five Lectures on Inorganic and Organic Chemistry will be delivered during the Winter Session, by A. H. Allen, F.C.S.

The Summer Course of Practical Chemistry is conducted by Mr. Allen.

SCOTLAND.

UNIVERSITY OF EDINBURGH.

Professor of Chemistry.—Dr. A. Crum Brown, F.R.S.

SCHOOL OF MEDICINE, EDINBURGH.

Lecturer on Chemistry.—Dr. Stevenson Macadam, F.R.S.E.

The Courses of Instruction in Chemistry include its applications to Medicine, Agriculture, and the Industrial Arts; and they qualify for the University of Edinburgh and other Universities, the Royal Colleges of Physicians and Surgeons, the Navy, Army, and Indian Medical Service, and the other Medical and Public Boards.

The Lectures on Chemistry are delivered daily during the five months of the Winter Session, commencing in November. The Lectures form a complete Course, and special Lectures on Technological Chemistry are given. Tutorial Class Examinations are held during the Session.

The Instructions in Analytical Chemistry are conducted in the Laboratories at Surgeons' Hall, which are open daily under the personal superintendence of Dr. Macadam, for the instruction of gentlemen in Chemical Analysis, and the prosecution of researches in Manipulative Chemistry.

The Prelections in Practical Chemistry are also conducted in the Laboratories at Surgeons' Hall. The subjects selected for Examination are those with which Medical Students are specially called upon to exhibit a practical acquaintance.

Fees.—Lecture, £3 5s. (University Graduation, £4 4s.) Practical Chemistry (University, &c.), £3 3s.; Analytical Chemistry, £2 per month, £5 for three months, or £10 for six months.

UNIVERSITY OF GLASGOW.

Professor of Chemistry and Practical Chemistry.—Dr. Thomas Anderson, F.R.S.E.

ANDERSONIAN UNIVERSITY, GLASGOW.

Professor of Scientific Chemistry.—Dr. T. E. Thorpe.

GLASGOW MECHANICS' INSTITUTION.

Professor of Chemistry and Practical Chemistry.—Dr. R. Carter Moffat.

GLASGOW VETERINARY COLLEGE.

Professor of Chemistry.—Dr. R. Carter Moffat.

SCHOOL OF CHEMISTRY,

42, BATH STREET, GLASGOW.

Dr. Wallace, Mr. Tatlock, and Dr. Clark.

Scientific Course of Lectures on Inorganic and Organic Chemistry, by Dr. Clark. From 12 till 1 daily. Commencing Tuesday, November 4. Fee for the course, £2 2s.

Laboratory Instruction in Analytical and Practical Chemistry, from 10 till 4 daily, Saturdays excepted. Commencing Tuesday, November 4. Fee for six months, exclusive of apparatus, £10 10s.

Evening Course of Laboratory Instruction in Analytical and Practical Chemistry. Tuesday and Thursday, from 7 p.m. till 9.30 p.m. Commencing November 4. Fee for one night per week, £1 1s. per quarter. Two nights per week, £2 2s. per quarter.

Evening Course of Lectures on Chemistry, in connection with the Practical Class, by Mr. Tatlock. Every Friday, from 8 p.m. till 9 p.m. Commencing November 7. Fee for the six months' course, 5s.

Spring Course of Practical Medical Chemistry, by Dr. Clark. Commencing Tuesday, January 6. Fee, £2 2s.

Summer Course of Practical Medical Chemistry, by Dr. Clark. Commencing Tuesday, May 4. Fee, £2 2s.

CHEMICAL LABORATORY AND CLASS ROOMS,
107, BATH STREET, GLASGOW.

Conducted by Dr. Milne.

The Laboratory is open daily from 10 till 4 (Saturdays excepted), for Instruction in Practical and Analytical Chemistry. Fee for six months, exclusive of apparatus, £10 10s. Fee for one month, £2 2s. Private Pupils (number limited to three) per month, £4 4s. Students can join the Laboratory at any time.

The Practical Evening Classes for Instruction in Analysis and Testing will meet on Tuesdays and Thursdays, from 7 p.m. till 9 p.m. Commencing November 4. Fee for one night per week, including apparatus and material, £1 1s. per quarter. Fee for two nights per week, £2 2s.

IRELAND.

DUBLIN.—TRINITY COLLEGE.

Professor of Chemistry.—Dr. Apjohn, F.R.S.

ROYAL COLLEGE OF SURGEONS, DUBLIN.

Professor of Chemistry.—Dr. Barker.

QUEEN'S COLLEGE, BELFAST.

Professor of Chemistry.—Dr. Andrews, F.R.S., &c.

QUEEN'S COLLEGE, GALWAY.

Professor of Chemistry.—Dr. T. H. Rowney.

A Laboratory for Practical Instruction is attached to all the Queen's Colleges. The usual Practical Course for the Medical Boards is given in the summer.

ROYAL COLLEGE OF SCIENCE FOR IRELAND,
STEPHEN'S GREEN, DUBLIN.

This College supplies, as far as practicable, a complete Course of Instruction in Science, applicable to the Industrial Arts. The subjects of Instruction are;—Pure and

Applied Mathematics, Descriptive Geometry and Mechanical Drawing, Mechanism, Theoretical and Applied Chemistry, Chemical Analysis, Physics, Botany, Zoology, Geology and Palaeontology, Mineralogy, Mining, Machinery, Surveying, and Agriculture.

Professor of Theoretical Chemistry.—W. K. Sullivan, Ph.D., V.P.R.I.A.

Professor of Analytical and Applied Chemistry.—R. Galloway, F.C.S.

Assistant-Chemist.—W. Plunkett, F.C.S.

A Course of Lectures on Inorganic and Organic Chemistry is delivered by Dr. Sullivan three times a week during the Session. Fee for the entire course, £2.

A Course of Lectures on Technological Chemistry is delivered by Mr. Galloway twice a week during the Session. Fee for the course, £2.

The Chemical and Metallurgical Laboratories, under the direction of Mr. Galloway, are open every week day during the Session, except Saturday. Instruction is given in the different branches of Analytical Chemistry, including Assaying, and in the methods for performing Chemical research. Each Student is taught, not in class, but separately and independently; and he is supplied with a separate working table, with reagents, fuel, water, gas, and the larger and more expensive apparatus. Fee, for the Session of nine months, £12; or for three months, £5; or for one month, £2.

There are four Royal Scholarships, of the value of £50 each yearly, with free Education, including Laboratory Instruction, tenable for two years; two become vacant each year: they are given to Students who have been a year in the College. There are also nine Exhibitions attached to the College, of the yearly value of £50 each, with free Education, including Laboratory Instruction, tenable for three years; three become vacant each year. The Exhibitions are awarded at the annual May Examinations of the Science and Art Department.

A Diploma of Associate of the College is granted at the end of the three years' course.

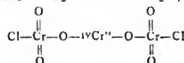
The Session commences on Monday, October 6th.

ON THE

ACTION OF CHROMYL DICHLORIDE ON IODINE.

By R. W. EMERSON McIVOR, Glasgow.

IN a paper communicated to the Literary and Philosophical Society of Manchester in November, 1859 (see CHEMICAL NEWS, vol. xx., p. 245), Dr. T. E. Thorpe announced the discovery of a new chromium oxychloride, obtained by heating chromyl dichloride, CrVO_2Cl_2 , in sealed tubes to about 185°C , and maintaining it at that temperature for three or four hours, when it undergoes decomposition, the products being this new oxychloride and free chlorine. After having submitted this new compound to a careful study, Dr. Thorpe was induced to give it the formula $\text{ClCrVO}_2\text{O} \cdot \text{O} \cdot \text{CrVO}_2\text{Cl}$, or—



and to regard it as the chromium term of a series of salts a few members of which had already been described by Peligot, viz.—

Potassium chlorochromate,	$\text{ClCrVO}_2\text{O} \cdot \text{K}_2$,	$\text{O} \cdot \text{CrVO}_2\text{Cl}$
Sodium	$\text{ClCrVO}_2\text{O} \cdot \text{Na}_2$,	$\text{O} \cdot \text{CrVO}_2\text{Cl}$
Ammonium	$\text{ClCrVO}_2\text{O} \cdot (\text{NH}_4)_2$,	$\text{O} \cdot \text{CrVO}_2\text{Cl}$
Magnesium	$\text{ClCrVO}_2\text{O} \cdot \text{Mg}^2$,	$\text{O} \cdot \text{CrVO}_2\text{Cl}$
Calcium	$\text{ClCrVO}_2\text{O} \cdot \text{Ca}^2$,	$\text{O} \cdot \text{CrVO}_2\text{Cl}$

From some experiments which I recently made, I find that chromium chlorochromate, together with iodine monochloride, is formed by the action of chromyl di-

chloride, CrVO_2Cl_2 , prepared by heating a mixture of potassium dichromate, sodium chloride, and sulphuric acid, on dry iodine. When these two bodies are mixed in the proportions represented in the equation—



and the mixture warmed, chemical action is manifested by the production of a slight crackling noise, and the whole becoming converted into a black solid substance possessed of a very powerful chlorid smell. If the product of the action be transferred to a distillation-flask, and submitted to distillation, iodine monochloride passes over into the receiver. The then remaining non-volatile portion is a black, brittle, amorphous, inodorous substance of a very hygroscopic nature. It is easily soluble in water, producing a dark brown-coloured solution, which smells of free chlorine. Carbon disulphide dissolves it but slightly. In strong hydrochloric acid it dissolves with a dark brown colouration, and, on boiling the solution, chlorine is evolved, the liquid becomes greenish yellow, and finally changes to the well-known green colour peculiar to an acid solution of chromic chloride. Upon boiling with dilute ammonium hydrate, chromic acid is dissolved, together with the whole of the chlorine, whilst chromate of chromium is precipitated as a greenish brown powder. When heated strongly in the air, it is resolved into chromic oxide, oxygen, and chlorine. It burns when heated in a stream of dry hydrogen gas, producing chromic oxide, water, and hydrochloric acid. Upon analysis it was found to be composed, in 100 parts, of—

Chlorine	21.58
Chromium	48.59
Oxygen (as difference) ..	29.83
	100.00

The theoretical percentage composition of Dr. Thorpe's compound being—

Chlorine	21.86
Chromium	48.54
Oxygen	29.60
	100.00

From the above considerations it is evident that the non-volatile residue consists of pure chromium chlorochromate.

ON THE ENERGIES OF THE IMPONDERABLES, WITH ESPECIAL REFERENCE TO THE MEASUREMENT AND UTILISATION OF THEM.*

By the Rev. ARTHUR RIGG, M.A.

(Continued from page 121.)

If the arms be held out horizontally, being raised direct from the sides, and not brought forward, they will be supported in that position by two muscles in each shoulder—or rather the portions of the two shoulder muscles which support them can be clearly defined and measured. The length of time for which this position can be maintained will, of course, vary considerably. The other evening I could hold mine in this position for only six minutes, that is to say, they became exhausted in this space of time. Therefore the sole power of the muscles employed was expended in maintaining the arm in that position for six minutes. Eight minutes will be found more near to the average.

Now let us consider what was happening whilst the arms were so held out. Clearly the muscles were giving off this note, that is to say, they are always giving it off when they are in action, and, therefore, the arm literally was swinging up and down, or vibrating, though to a very small and invisible extent. It would do so much more but for this peculiar arrangement; whilst the muscle contracts and produces the action that we usually call mus-

cular action, that contraction does not take place through the entire mass of muscle at the same time. Each fibre contracts, but not in the same portion of the muscle and at the same time; there are waves succeeding waves, and the consequence is that there is, to all appearance, a steadiness in the arms through the continuity of these waves. But, as regards the action, it is the same as though that wave passed along at once. Now, if the wave passed along at once then the arm would fall, because it would oscillate or move up and down as a wave does. Knowing how often that wave passes, you would know how often the arm fell. The arm falls 32 times per second. It fails as if it were perfectly free, and if perfectly free we can easily calculate the space through which it would have fallen in the 32nd part of a second, namely, the $\frac{1}{32}$ th of a foot; in other words, we have reached this stage, that the action of a muscle is such that it allows the arm to fall through the 64th part of a foot in the 32nd part of a second. Now let us get to another stage. The cause of its falling is the action of gravity upon the whole mass of the arm. You may remember that last Monday, in dealing with the pendulum, it was explained that in a compound pendulum different portions fell through different spaces, but that there is one point which we called O, termed the centre of oscillation, which may be regarded as representing the whole mass. Now, assuming a shoulder to be the point of suspension of the pendulum, it is the point O in the arm which would fall through the 64th part of a foot in the 32nd part of a second, and that point O, by a mathematical calculation, can always be found. Regarding the arm as a perfect cylinder, this point is at two-thirds of the length of the arm from the shoulder.

Again, the work done depends on the mass moved, or supported, and the mass moved is that which is calculated as at the centre of gravity, which for this purpose is about the elbow—about eleven inches from the shoulder. Therefore, assuming the arm to be 24 inches, then the point O at 16 inches from the shoulder, falls through the 64th part of a foot, in the 32nd part of a second, and it is very easy from that to ascertain how far the point at 11 inches from the shoulder, representing the whole weight of the arm, would fall in the same interval of time. We have, therefore, got the centre of gravity, the weight of the arm, and the distance it falls.* We consequently have all the elements wanted. We have the mass, the weight of the arm, the space (the $\frac{1}{32}$ th of the foot), and the time ($\frac{1}{32}$ nd of a second). Without going into the question of mathematics, the work done under these circumstances, as regards my own arm, was this, that I was able to do with both arms 1980 lbs. in the six minutes that elapsed before fatigue came on; in other words, the work done was the same as though I had lifted 1980 lbs. 1 foot high—1980 lbs. is very nearly 18 cwt. That is to say, the work that these two arms did in falling through that space, and being lifted back again, was very little short of a ton. If any one wants to know how much work the human arm is capable of doing when working on its own account, he may raise weights amounting to 9 cwt. on to a stool 1 foot high, and he would then ascertain the exact work that each arm did when left to support itself. Such is an outline of the mode in which the calculation is made. If there are any persons interested in it, as a question of actual calculation, a table on the wall may be of interest.†

* Dr. H. calls his and many other similar experiments "Statistical," although reference is made to motion, because the muscles are kept in continued contraction until tired out, and undergo no translation in space, although a rapid and active molecular movement takes place within the muscles to which the work done is altogether due.

† To find the work done in holding arms horizontal, time before exhaustion being six minutes:—

From measurement, length of each arm is 24 inches.

From weighing, weight of each arm is 18 lbs.

From muscular note, vibration of each arm is 32 times per second.

From table, centre of oscillation of each arm is 2-8ths of 24 inches, or 16 inches from shoulder.

From inspection, centre of gravity of each arm is 11 inches from shoulder.

* The Cantor Lectures, delivered before the Society of Arts.

The arm in this case was held steady, and doing what may be called static work, as distinguished from that which is dynamical or kinetic. Dr. Haughton took very great pains to ascertain the exact weight of these muscles in the shoulder. This was done thus:—There is a large muscle called the "deltoid" muscle; a portion only of this muscle is engaged in the work. After careful examination in various ways Dr. Haughton concluded that $\frac{1}{12}$ ths of this muscle is employed in the experiment. It would be out of place to enter into these details here; it may, however, be of general interest to place this investigation before you in a tabular form.

Average weight of superapinatus muscle	Ozs. avoird.
Average of portion of deltoid	1671
	2830
	4501

Therefore 4½ ozs. perform, on an average, 1206½ ft.-lbs.
" 1 oz. performs 268 ft.-lbs. before being exhausted.

As this exhaustion is complete in 8·29 minutes, the average duration of endurance, 1 oz. in 1 minute does 268 = 32½ ft.-lbs.
8·29

On one occasion these muscles were weighed and measured within 40 minutes after the execution of a criminal, so as to ascertain the exact size of them under circumstances where there had been no wasting from exhaustion. With the shoulder unloaded, the muscle was tired out in 8·29 minutes on an average of experiments. The weight of the muscles employed was 41 ozs., and the work they did on an average was equivalent to the lifting of 1206 lbs. through a foot. The weight lifted through one foot for 1 ounce of muscle would be 32 lbs. He then put a weight of 2 lbs. in each hand, and held them out as before until fatigued, and he found the muscles were exhausted in 4 minutes, but the amount of work which each ounce of muscle did was 46 lbs., so that it did more work than it did before. Now, the power of the heart to send blood into the muscles, to keep up the action there, is not, in this case, equal to the action or work required from them; hence they began to fail in 4 minutes, whereas, in the other case, they kept at work for 8 minutes. In fact, the power exactly balanced the work in the 8 minutes; but it fell rather short in 4 minutes. An experiment was tried in another form, namely, hanging a weight on the wrist and keeping the elbow close to the side, a different muscle (biceps) came into play. This muscle weighs about 8 ozs.; the power lasted 9½ minutes, and the weight, per ounce of muscle, lifted was 41.

Now, coming to dynamical work, when the muscles are engaged in producing motion, the muscles of the trunk of the body are employed simply in supplying the other muscles with that upon which they live during the time they are at work; they do no external work themselves. This was alluded to in an early part of the lecture, when told that there are certain muscles which

Now from the usual expression—

$$S = \frac{1}{2} G T^2$$

$$\text{In this case } S = \frac{1}{2} \times 32 \left(\frac{1}{32} \right)^2$$

$$= \frac{1}{64} \text{ foot.}$$

Therefore centre of oscillation falls through $\frac{1}{64}$ in. in $\frac{1}{32}$ of a second,
or " " " " $\frac{60 \times 32}{64}$ i.e., 30 feet in one minute.

If at 16 inches from the shoulder there is a fall of 30 feet per minute, then at 21 inches from the shoulder there is a fall of $\frac{17 \times 30}{16}$ feet per minute.

Therefore the work done by one arm is $\frac{8 \times 17 \times 30}{16}$ ft.-lbs. per minute.
 $\frac{106 \times 6}{16}$ ft.-lbs.

Therefore "total work" by both arms before exhaustion is 106·6 ft.-lbs., or 1080 ft.-lbs., that is nearly 18 cwt. lifted through one foot in six minutes.

act involuntarily; for example, if the heart cannot propel blood as fast as the muscle needs it, and if the will insists upon that muscle doing further work, then the heart is called upon to do what it cannot do, and death ensues. The two must be harmonised; and where this harmony is broken, as sometimes happens, in a boat-race, and other cases of violent exertion, accident or death results.

STATICAL WORK DONE BY MUSCLES.

Muscles used.	Work in foot-pounds.	Duration of labour, in minutes.	Weight of muscles in ounces avoird.	Rate of work in foot-lbs. per oz. per min
Unloaded muscles of shoulder	1206	8·29	4·50	32½
Loaded muscles of shoulder	842	4·05	4·50	46½
Loaded muscles of forearm	3170	9·29	8·21	41½

DYNAMICAL WORK DONE BY MUSCLES OF THE WHOLE BODY.

Kind of Work.	Quantity of work in foot-pounds.	Duration of labour, in minutes.	Weight of muscles in ounces avoird.	Rate of work in ft.-lbs. per oz. per minute.
Boat race	61,040	7	575	15·17
Barrow lift	2,038,400	480	575	7·39
Running with load	10,091	0·55	575	35·11
Day labour	792,400	600	575	2·30

This table shows the results of experiments on different kinds of work. First, there is the case of a boat race which was rowed in seven minutes. The whole weight of the muscles employed in actually doing the work, viz., those in the arms and legs, was 575 ozs.; the work done, making all allowances for the weight of the boat and the people in it, &c., was equivalent to 60,040 lbs. raised through a foot, giving an average of only 15 lbs. per ounce per minute, so that the contrast is very great between static work and dynamical work, the former being three times as great. Next comes an instance bringing into play all the active muscles of the body. It was a plan adopted in some railway works, raising rubble from a great depth. There was a pulley at the top of a shaft, over which passed a rope, and a stage at each side large enough to carry a barrow. One barrow was filled at the bottom, then a man stepped into the empty barrow at the top, and his weight in falling to the bottom of the shaft lifted the barrow full of earth. He then ran up a ladder to the top, and was ready to descend again. By that means his own weight lifted up the full barrow of earth. With work like that a man worked for 480 minutes, and he did two millions of units of work. Compared with the boat race he was only half as industrious, and the length of time was very much greater, but he only did 7·39 foot-lbs. per oz. per minute. In the next case a man ran with a load upon his shoulders, and his muscular power was knocked up in half a minute, but the work he did was 35 foot-lbs. per minute, approaching very nearly the static work. Last comes a day labourer, who generally takes it very easy, and it appears he only does 2 foot-lbs. per oz. per minute, so that if he complains of getting small pay he does little work for it; it must be remembered, however, that he works for 10 hours a day at it.

Time warns me to close. It may, however, be of interest to state that, calculated as machinery would be calculated, the heart receives and propels the whole amount of blood in the human body in 42 seconds.

To those who care for the subject of this evening's lecture, and have not altogether laid aside their mathematical knowledge, the information in Dr. Haughton's book will prove both instructive and interesting. To follow up the investigation, they may study the action of a horse in walking and drawing a load, also the construction of carriages, so that the animal may most easily raise a

loaded cart over an obstacle on the road, and, further, decide upon the inclination of the traces to the roadway. These being done, the investigator will find much scope for original work in examining the various ways in which horses are harnessed so as to utilise their vital energies. This done, boats and bicycles, as means of utilising muscular energy, are worthy of thought. Perplexity and confusion seem to be stamped upon modern usages in these matters, and the conclusion is forced upon us that the utilisation of the vital energies has not yet been reduced to a system.

(To be continued).

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopaedic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgement. The two half-yearly volumes of the Chemical News, with their copious indices, will, therefore, be equivalent to an English edition of the "Zusammenberichte."

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, August 18, 1873.

Fourth Notice on Guano.—M. Chevreul.—The author gives a description of a crystalline matter extracted by cold water from the guano, and of another complex substance insoluble in cold water. It contains a considerable amount of avic acid, but does not give off the odour of this body until treated with alcohol. "Lastly, in the residue of the guano, after exhaustion with cold water, boiling alcohol, and boiling water, there remains phosphate of lime in a particular state, to which I shall return in a final notice, where I shall show how my experiments throw a new light upon the part played by guano in agriculture, and how it realises in practice all the theoretical views which I have made known thirty years ago on the conception of a typical manure."

Ammonio-Nitrometry; a new System for Determining Ammonia and Nitrogen in Organic Compounds, and Nitric Acid in Natural Waters, Soils, and Manures.—M. Piuggari.—The most important data to be determined in all these cases are ammonia, free and combined, nitrogen existing in organic matters, and nitric acid or nitre derived from the oxidation of such matters. The general means to be employed are oxidation and reduction; but as all the agents employed hitherto are neither energetic nor pure enough to give results sufficiently exact, the author adopts, at once as oxidising and as reducing agent for organic matters, a mixture of chloride of silver, moist and recently precipitated, and of very pure hydrate of potassa. These substances, which are very energetic, and which may be obtained quite free from ammonia, are allowed to act for two or three hours at a temperature of 55° to 60°. By this action all the nitrogen of the organic matters is transformed into ammonia, nitrous, and nitric acid; the two latter of which are then transformed into ammonia by reducing agents. The reducing agent which the author employs in this case—as in all those where it is required to reduce and determine nitrous compounds—is nascent hydrogen produced by aluminium filings, and a pure alkaline hydrate at a temperature which ought not to exceed that of boiling water. The process is continued for half-an-hour to an hour according to the amount of the matter to be reduced, and the ammonia is then distilled off. The author has convinced himself of the complete reduction by this process of organic matters and nitrous compounds by experimenting with types of known

composition, such as morphia, codeia, strychnia, albuma gelatin, and uric acid. The amount of albumen obtained has been in accordance with theory, with a difference of at most 1 to 3 per cent, due doubtless to the very small quantities operated upon—0.0005 grm. to 0.0002 grm. per half litre of water. The ammonia distilled over is determined by Nessler's test if the quantities are very small. If they exceed $\frac{1}{100}$ th of a milligram of ammonia per cubic centimetre, the determination is effected by means of a special reagent, founded on the reaction of 1 or 2 drops of phenol, and 5 to 6 c.c. of hypochlorite of soda added to the liquid to be tested. This reagent gives with the distilled ammoniacal liquid a fine blue violet colouration, soluble and very stable; the intensity of which may be compared with a normal liquor by means of Collardeau's colorimeter.

Hydrochlorate of Tereben, and the Isomerism of the Compounds of the Formula $C_{10}H_{16}HCl$.—M. J. Ribau.—The hydrochlorate of tereben is completely without action upon polarised light; it forms crystals of a camphor-like odour, and recalls in certain respects the hydrochlorates of terebenthen and camphen. Its composition is:—

Carbon	69.8
Hydrogen	9.85
Chlorine	20.37

100.00

It melts at 125°, and is quickly decomposed by water, which removes the bulk of the hydrochloric acid, converting the substance into a mixture of a crystalline carbide, $C_{10}H_{16}$, which the author calls β -camphen, and of undecomposed hydrochlorate. The hydrochlorate dissolves in hot absolute alcohol; and if the temperature of 55° to 60° is not exceeded the bulk of the product is deposited in fine transparent laminae, not containing more than 17 to 18 per cent of chlorine. The author concludes that the hydrochlorate of terebenthen is undecomposable by cold water, and yields only traces of hydrochloric acid at 100°. The hydrochlorates of camphen are slowly decomposed by cold water, and by the same liquid at the boiling-point; the primitive crystalline camphen being regenerated. The hydrochloric ethers of the two borneols experience an analogous decomposition under the same circumstances, but with less intensity. The hydrochlorate of tereben is dissociated at ordinary temperatures; it is decomposed most rapidly by the action of cold water, and under the same influence at 100° furnishes only liquid compounds, contrary to what has been observed with the liquid combinations of the camphens and the borneols.

Direct Demonstration of the Fundamental Principles of Thermo-Dynamics.—(Continued.)—M. Ledieu.—This treats of the fundamental relation between the quantity of heat applied to a body, the change of temperature, and the variation and duration of the vibrations.

Letter from M. Nordenskjöld on Carbonaceous Dust, with Metallic Iron, observed in Snow. (Dated from Mossel Bay, lat. 79° 53' N.; Received at Tromsøe, July 24).—The writer remarks that in December, 1871, he found in some snow collected towards the end of a five or six days continuous fall in Stockholm a large quantity of dark powder like soot, and consisting of an organic substance rich in carbon. It was like the meteoric dust which fell with meteorites at Hesse near Upsal in Jan., 1869. It contained also small particles of metallic iron. Suspecting the railways and houses of Stockholm might have furnished these matters, he got his brother, who lived in a desert district in Finland, to make similar experiments; which he did, and obtained a similar powder. In his Arctic voyage the writer has met with like phenomena. The snow from floating ice has furnished on fusion a greyish residue consisting mostly of diatoms (whole or injured); but the black specks, a quarter of a millimetre in size, contained metallic iron covered with oxide of iron, and probably also carbon.

He thinks, therefore, that snow and rain convey cosmic dust to the earth, and invites further observation on the subject. M. Daubree, in presenting the letter, recalled a case of meteoric dust having fallen at Orgeuil in 1864. He expressed the hope that M. Nordenskjöld has obtained sufficient quantities of pulverulent matter to be able to determine a characteristic fact—the presence or absence of nickel.

The Cryptograph of M. Pelegrin.—M. Dupuy de Lôme. The cryptograph is described as an instrument designed to be raised on the ground, and to convert into expressions capable of being transmitted directly and secretly by telegraph, the polar co-ordinates of points which determine a given figure; whence the possibility with this instrument of following and interpreting, that is, of drawing, in Paris, *c.g.*, what correspondents in different parts of the country in telegraphic communication with Paris may see and telegraph but do not interpret.

Experimental Researches on Explosive Matters.—MM. Roux and Larran.—The authors formerly determined the heat of combustion of five kinds of powder made in France. They here determine for these powders the volume of the gaseous products of combustion reduced to zero and 0.76 m. Their tables also give the numbers expressing heat of combustion; the pressure of the permanent gases of 1 kilo. of powder, having at the temperature *T* of the flame a volume equal 1 litre; and the maximum work produced by indefinite expansion of the gases of 1 kilo. Some other substances, as gun-cotton, dynamite, were also experimented with.

Variations of Hæmoglobin in the Zoological Series.—M. Quinquaud.—The progressive diminution of quantity of hæmoglobin in the same volume of blood generally follows the animal scale; but primates have not much hæmoglobin. Young animals have less than adults. From about 25 to 50 years in man the proportion is pretty constant; thereafter it diminishes. Birds have much less hæmoglobin than mammals. Females have less than males. The lymph of crustacea has 4 to 5 c.c. of oxygen per cent, while ordinary water, at its maximum of saturation in winter, contains only 1 c.c. per cent; and in summer, $\frac{1}{10}$ c.c. M. Quinquaud gives a list of animals, with the proportion of hæmoglobin in each.

Former Existence during the Quaternary Period of a Large Glacier in the Mountains of Aubrac (Lozère).—M. G. Faber.

Three Short Notes on Falling Stars.—MM. Dufour, Tisserand, and Chapelier respectively.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, Tome xxxi., No. 18, August 28, 1873.

Relation between the Atomic Weight, the Specific Gravity, and the Hardness of the Metallic Elements.—S. Botone.—The author holds that the hardness of any metallic element has for its natural measure the quotient or ratio of the specific gravity divided by the atomic weight. The theoretical results thus obtained agree closely with the hardness determined experimentally by causing a cylinder of steel to penetrate to a constant depth into the metal in question by means of a determinate rotatory movement.

MISCELLANEOUS.

The Adulteration Act.—Mr. Alfred G. Anderson has been elected Analyst to the Vestry of St. Martin-in-the-Fields, London.

Birkbeck Literary and Scientific Institution.—This Institution has just issued its prospectus for the winter session. Evening classes for ladies and gentlemen have been arranged in all branches of education, and a class is announced for the preparation of candidates for the Civil

Service Open Competitions. Professor Fawcett, M.P., has kindly consented to deliver an address in commemoration of the opening of the fifth session. During the vacation the interior of the lecture theatre has been entirely reconstructed. The list of lectures contains the names of several of the most popular occupants of the platform. Important additions have been made to the library, and the reading room is well supplied with current literature.

British Association for the Advancement of SCIENCE.

The Forty-third ANNUAL MEETING of this Association will be held in BRADFORD, commencing on WEDNESDAY, September 17, 1873.

President Designate:

Professor A. W. WILLIAMSON, Ph.D., F.R.S., F.C.S.

Election of Members and Associates.

The Executive Committee at Bradford will elect New Members and Associates on the following conditions:—

- I. New Life Members for a composition of £10, which entitles them to receive gratuitously the Reports of the Association which may be published after the date of payment.
- II. New Annual Subscribers for a payment of £2 for the first year. They receive gratuitously the Reports for the year of their admission and for every following year in which they continue to pay a Subscription of £1 without intermission.
- III. Associates for their Meeting only for a payment of £1. They are entitled to receive the Report of the Meeting at two-thirds of the publication price. Associates are not eligible to serve on Committees or to hold any office.

Ladies may become Members or Associates on the same terms as Gentlemen. Ladies' Tickets (transferable to Ladies only) may be obtained on payment of £1. Cheques and Post-Office Orders to be made payable to Alfred Harris, Jun., Esq., Bradford.

After September 13, personal application for Tickets must be made at the Reception Room, Bradford, which will be opened on Monday, September 15, at 1 p.m.

General and Evening Meeting in St. George's Hall.

The First General Meeting will be held on Wednesday, September 17, at 8 p.m. precisely, when Dr. CARPENTER, LL.D., F.R.S., &c., will resign the Chair, and the President Elect will assume the Presidency, and deliver an Address. On Thursday, Evening, September 18, at 8 p.m., a Soirée; on Friday Evening, September 19, at 8.30 p.m., a Discourse by Professor W. C. Williamson, F.R.S., of Manchester, on Coal and Coal Plants; on Saturday Evening, September 20, a Lecture on Fuel, to Working Men only, by Mr. Siemens, F.R.S.; on Monday Evening, September 22, at 8.30 p.m., a Discourse on Molecules, by Professor Clerk Maxwell, F.R.S.; on Tuesday Evening, September 23, at 8 p.m., a Soirée; on Wednesday, September 24, the concluding General Meeting will be held at 8.30 p.m., and in the Evening a Grand Concert will be given in St. George's Hall, at 8 p.m.

EXCURSIONS on Thursday, the 25th September, to the following places of interest have been arranged:—Harrogate, Ripon, Studley, Bolton Abbey, Gordale Scar, Malham, Clapham Caves, Settle Caves, and Ingleborough.

Lists and Prices of Lodgings, and other general information will be given, on application at the Local Secretaries' Office, Bradford.

The names of New LIFE MEMBERS, ANNUAL SUBSCRIBERS, and ASSOCIATES for this Meeting only, are now being received and Tickets issued at the Offices of the Association, Market Street; also Tickets for Ladies who do not desire to become Members or Associates: these are transferable to Ladies only.

JAMES R. CAMPBELL, D.D., Hon. Sec.
RICHARD GODDARD, Hon. Sec.
PEILE THOMPSON, Hon. Sec.

North London School of Chemistry, Pharmacology, &c. Established 24 years—Founded by Mr. J. C. BRAITHWAITE, for thirteen years Principal Instructor in the Laboratories of the Pharmaceutical Society of Great Britain, and Demonstrator of Practical Pharmacy, Pharmaceutical Latin, &c.

The Session 1873-1874 commences on the 1st of October, when—
The LABORATORY will be open for instruction in Practical Chemistry as applied to Pharmacy, Medicine, Analysis, &c. Terms moderate.

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Fee to either Class Half-a-Guinea per Month. Pupils desirous of doing so can attend until qualified for one inclusive Fee.

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BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

BRADFORD MEETING, SEPTEMBER 17, 1873.

INAUGURAL ADDRESS OF THE PRESIDENT,
ALEXANDER W. WILLIAMSON, PH.D., F.R.S., F.C.S.

LADIES AND GENTLEMEN,—

INSTEAD of rising to address you on this occasion, I had hoped to sit quietly amongst you, and to enjoy the intellectual treat of listening to the words of a man of whom England may well be proud—a man whose life has been spent in reading the great book of nature, for the purpose of enriching his fellow men with a knowledge of its truths—a man whose name is known and honoured in every corner of this planet to which a knowledge of science has penetrated—and, let me add, a man whose name will live in the grateful memory of mankind as long as the records of such noble work are preserved.

At the last Meeting of the British Association I had the pleasure of proposing that Dr. Joule be elected President for the Bradford Meeting, and our Council succeeded in overcoming his reluctance and in persuading him to accept that office.

Nobly would Joule have discharged the duties of President had his bodily health been equal to the task; but it became apparent after a while that he could not rely upon sufficient strength to justify him in performing the duties of the chair, and, in obedience to the orders of his physician, he placed his resignation in the hands of the Council about two months ago. When, under these circumstances, the Council did me the great honour of asking me to accept their nomination to the Presidency, I felt that their request ought to have with me the weight of a command.

For a good many years past Chemistry has been growing at a more and more rapid rate, growing in the number and variety of facts which are added to its domain, and not less remarkably in the clearness and consistency of the ideas by which these facts are explained and systematised. The current literature of chemical research extends each year to the dimensions of a small library; and mere brief abstracts of the original papers published annually by the Chemical Society, partly aided by a grant from this Association, take up the chief part of a very stout volume. I could not, if I would, give you to-night even an outline of the chief newly discovered compounds and of the various changes which they undergo, describing each of them by its own name (often a very long one) and recording the specific properties which give to each substance its highest scientific interest. But I am sure that you would not wish me to do so if I could; for we do not meet here to study chemistry; I conceive that we meet here for the purpose of considering what this wonderful activity in our science means, what is the use of it, and, true to our object as embodied in the name of this Association, to consider what we can do to promote the Advancement of Science. I propose to lay before you some facts bearing on each of these questions, and to submit to you some considerations respecting them.

In order to ascertain the meaning of the work which has been going on in chemistry, it will, I think, be desirable for us to consider the leading ideas which have

been in the minds of chemists, and which guided their operations.

Now, since the father of modern chemistry, the great Dalton, gave to chemists a firm hold of the idea of Atoms, their labours have been continually guided by that fundamental idea, and have confirmed it by a knowledge of more and more facts, while at the same time steadily adding to our knowledge of the properties of atoms. Every chemist who is investigating a new compound takes for granted that it must consist of a great number of atom-clusters (called by him molecules), all of them alike, and each molecule consisting of a certain number of atoms of at least two kinds. One of his first endeavours is to ascertain how many atoms of each kind there are in each molecule of the compound. I must not attempt to describe to you the various kinds of experiment which he performs for the purpose of getting this information, how each experiment is carried out with the aid of delicate instruments and ingenious contrivances found by long experience to enable him to obtain the most trustworthy and accurate results; but I want to draw your attention to the reasoning by which he judges of the value of such experiments when they agree among themselves, and to the meaning which he attaches to their result.

If the result of his experiments does not nearly agree with any atomic formula (that is, if no conceivable cluster of atoms of the kinds known to be in the compound would on analysis give such results as those obtained), the chemist feels sure that his experiments must have been faulty: either the sample of substance which he worked upon contained foreign matter, or his analyses were not made with due care. He sets to work again, and goes on till he arrives at a result which is consistent with his knowledge of the combining properties of atoms. It is hardly necessary to say that even the best experiment is liable to error, and that even a result obtained with the utmost care cannot be expected to afford more than an approximation to the truth. Every good analysis of a pure compound leads to results which approximate to those required by the Atomic Theory; and chemists trust so thoroughly to the truth of that guide, that they correct the results of such analysis by the aid of it.

The chemical idea of atoms serves for two purposes:—

(1). It gives a clear and consistent explanation of an immense number of facts discovered by experiment, and enables us to compare them with one another and to classify them.

(2). It leads to the anticipation of new facts, by suggesting new compounds which may be made; at the same time it teaches us that no compounds can exist with their constituents in any other than atomic proportions, and that experiments which imply the existence of any such compound are faulty.

We have the testimony of the great Berzelius to the flood of light which the idea of atoms at once threw on the facts respecting combining proportions which had been accumulated before it was made known; and from that time forward its value has rapidly increased as each succeeding year augmented the number of facts which it explained.

Allow me at this point of my narrative to pause for a moment in order to pay a tribute of respect and gratitude to the memory of one who has recently passed from among us, and who in the time of his full activity was a leader of the discoveries of new facts in the most difficult part of our science. Liebig has been generally known in this country through his writings on agricultural chemistry, through his justly popular letters on chemistry, and other writings, by means of which his brilliant intellect and ardent imagination stimulated men to think and to work. Among chemists he was famed for his numerous discoveries of new organic compounds, and his investigation by the aid of improved methods; but I believe that the greatest service which his genius rendered to science was the establishment of the chemical school of Gießen, the prototype of the numerous chemical schools for which

Germany is now so justly celebrated. I think it is not too much to say that the Giessen laboratory, as it existed some thirty years ago, was the most efficient organisation for the promotion of chemistry which had ever existed.

Picture to yourselves a little community of which each member was fired with enthusiasm for learning by the genius of the great master, and of which the best energies were concentrated on the one object of experimental investigation.

The students were for the most part men who had gone through a full curriculum of ordinary studies at some other university, and who were attracted from various parts of the world by the fame of this school of research.

Most of the leading workers of the next generation were pupils of Liebig; and many of them have established similar schools of research.

We must not, however, overlook the fact that Liebig's genius and enthusiasm would have been powerless in doing this admirable work, had not the rulers of his Grand Duchy been enlightened enough to know that it was their duty to supply him with the material aids requisite for its successful accomplishment.

Numberless new compounds have been discovered under the guidance of the idea of atoms; and in proportion as our knowledge of substances and of their properties became more extensive, and our view of their characteristics more accurate and general, were we able to perceive the outlines of their natural arrangement, and to recognise the distinctive characteristics of various classes of substances. I wish I could have the pleasure of describing to you the origin and nature of some of these admirable discoveries, such as homologous series, types, radicals, &c.; but it is more to our purpose to consider the effect which they have had upon the idea of atoms, an idea which, still in its infancy, was plunged into the intellectual turmoil arising from a variety of novel and original theories suggested respectively by independent workers as best suited for the explanation of the particular phenomena to which their attention was mainly directed.

Each of these workers was inclined to attach quite sufficient importance to his own new idea, and to sacrifice for its sake any other one capable of interfering with its due development.

The father of the atomic theory was no more; and the little infant had no chance of life, unless from its own sterling merits it were found useful in the work still going on.

What then was the result? Did it perish like an ephemeral creation of human fancy? or did it survive and gain strength by the inquiries of those who questioned Nature and knew how to read her answers?

Although anticipating my answer to these questions, you will probably be surprised to hear the actual result which I have to record, a result so wonderful that the more I think of it the more I marvel at it. Not only did these various theories contain nothing at variance with the atomic theory; they were found to be natural and necessary developments of it, and to serve for its application to a variety of phenomena which were unknown to its founder.

Among the improvements of our knowledge of atoms which have taken place, I ought to mention the better evaluations of the relative weight of atoms of different kinds, which have been made since Dalton's time. More accurate experiments than those which were then on record have shown us that certain atoms are a little heavier or lighter than was then believed, and the work of perfecting our observations is constantly going on with the aid of better instruments and methods of operation. But, apart from these special corrections, a more sweeping change has taken place, not in consequence of more accurate experiments interpreted in the usual way, but in consequence of a more comprehensive view of the best experimental results which had been obtained, and a more consistent interpretation of them. Thus the atomic weight of carbon had been fixed at 6 by

Dumas's admirable experiments; and it was quite conceivable that a still more perfect determination might slightly increase or diminish this number. But those who introduced the more sweeping change asserted in substance that two of these supposed atoms, whatever may be the precise weight of each, always are together and never separate from one another; and they accordingly applied the term atom to that indivisible mass of carbon weighing twice as much as a carbon atom had been supposed to weigh. So also with regard to other elements, it has been shown that many atoms are really twice as heavy as had been supposed, according to the original interpretation of the best experiments. This change was brought about by what I may be permitted to call the operation of stock-taking. Dalton first took stock of our quantitative facts in a business-like manner; but the amount and variety of our chemical stock increased so enormously after his time, that the second stock-taking absorbed the labours of several men for a good many years. They were men of different countries and very various turns of mind; but, as I mentioned just now, they found no other fundamental idea to work with than Dalton's; and the result of their labours has been to confirm the truth of that idea and to extend greatly its application.

One of the results of our endeavours to classify substances according to their natural resemblances has been the discovery of distinct family relationships among atoms, each family being distinguished by definite characteristics. Now, among the properties which thus characterise particular families of atoms, there is one of which the knowledge gradually worked out by the labours of an immense number of investigators must be admitted to constitute one of the most important additions ever made to our knowledge of these little masses.

I will endeavour to explain it to you by a simple example. An atom of chlorine is able to combine with 1 atom of hydrogen or 1 atom of potassium; but it cannot combine with 2 atoms. An atom of oxygen, on the other hand, can combine with 2 atoms of hydrogen or with 2 atoms of potassium, or with 1 atom of hydrogen and 1 of potassium; but we cannot get it in combination with 1 atom of hydrogen or of potassium solely.

Again, an atom of nitrogen is known in combination with 3 atoms of hydrogen; while an atom of carbon combines with 4 of hydrogen. Other atoms are classified, from their resemblance to these respectively, as Monads, Dyads, Triads, Tetrads, &c.

The combining value which we thus recognise in the atoms of these several classes has led us naturally to a consideration of the order in which atoms are arranged in a molecule. Thus, in the compound of oxygen with hydrogen and potassium, each of these latter atoms is directly combined with the oxygen, and the atom of oxygen serves as a connecting link between them. Hydrogen and potassium have never been found capable of uniting directly with one another; but when both combined with 1 atom of oxygen they are in what may be called indirect combination with one another through the medium of that oxygen.

One of the great difficulties of chemistry some few years ago was to explain the constitution of isomeric compounds, those compounds whose molecules contain atoms of like kinds and in equal numbers, but which differ from one another in their properties. Thus a molecule of common ether contains 4 atoms of carbon, 10 atoms of hydrogen, and 1 of oxygen. Butylic alcohol, a very different substance, has precisely the same composition. We now know that in the former the atom of oxygen is in the middle of a chain of carbon atoms, whereas in the latter it is at one end of that chain. You might fancy it impossible to decide upon anything like consistent evidence such questions as this; but I can assure you that the atomic theory, as now used by chemists, leads frequently to conclusions of this kind, which are confirmed by independent observers, and command general assent.

That these conclusions are, as far as they go, true descriptions of natural phenomena is shown by the fact that each of them serves in its turn as a stepping-stone to further discoveries.

One other extension of our knowledge of atoms I must briefly mention, one which has as yet received but little attention, yet which will, I venture to think, be found serviceable in the study of the forces which bring about chemical change.

The original view of the constitution of molecules was statical; and chemists only took cognizance of those changes of place among their atoms which result in the disappearance of the molecules employed, and the appearance of new molecules formed by their reaction on one another. Thus, when a solution of common salt (sodic chloride) is mixed with a solution of silver nitrate, it is well known that the metallic atoms in these respective compounds change places with one another, forming silver chloride and sodic nitrate; for the silver chloride soon settles to the bottom of the solution in the form of an insoluble powder, while the other product remains dissolved in the liquid. But as long as the solution of salt remained undecomposed, each little molecule in it was supposed to be chemically at rest. A particular atom of sodium which was combined with an atom of chlorine was supposed to remain steadily fixed to it. When this inactive solution was mixed with the similarly inactive solution of silver nitrate, the interchange of atoms known to take place between their respective molecules was nominally explained by the force of predisposing affinity. It was, in fact, supposed that the properties of the new compounds existed and produced effects before the compounds themselves had been formed.

I had occasion to point out a good many years ago that molecules which appear to be chemically at rest are reading on one another when in suitable conditions, in the same kind of way as those which are manifestly in a state of chemical change—that, for instance, the molecules of liquid sodic chloride exchange sodium atoms with one another, forming new molecules of the same compound undistinguishable from the first, so that, in an aggregate of like molecules, the apparent atomic rest is the result of the interchange of like atoms between contiguous molecules.

Such exchanges of atoms take place not only between molecules of identical composition, but also between contiguous molecules containing different elements. For instance, in a mixture of sodic chloride and potassic iodide an interchange of metallic atoms takes place, forming potassic chloride and sodic iodide. The result of the exchange in such a case is to form a couple of new molecules different from the original couple. But these products are subject to the same general law of atomic exchanges, and their action on one another reproduces a couple of molecules of the materials.

Thus a liquid mixture formed from two compounds, contains molecules of four kinds, which we may describe as the two materials and the two products. The materials are reading on one another, forming the products; and these products are, in their turn, reading on one another, reproducing the materials.

If one of the products of atomic exchange between two molecules is a solid while the other remains liquid (as when sodic chloride is mixed with silver nitrate), or if one is gaseous while the other remains liquid, so that the molecules of the one kind cannot read on those of the other kind and reproduce the materials, then the continued reaction of the materials on one another leads to their complete mutual decomposition. Such complete mutual decomposition of two salts take place whenever they react on one another under such conditions that the products cannot react on one another and reproduce the materials; whereas partial decomposition takes place whenever the materials form a homogeneous mixture with the products.

Now, if in any such homogeneous mixture more ex-

changes of atoms take place between the materials than between the products, the number of molecules of the products is increased, because more of them are being made than unmade; and reciprocally, if more exchanges of atoms take place between the products than between the materials, the number of molecules of the materials is increased. The mixture remains of constant composition when there are in the unit of time as many decomposing changes as reproducing changes.

Suppose that we were to determine by experiment the proportion between the number of molecules of the materials, and the number of molecules of the products, in a mixture the composition of which remains constant, and that we found, for instance, twice as many of materials as of products; what would this mean? Why, if every two couples of materials only effect in the unit of time as many exchanges as every one couple of products, every couple of materials is only exchanging half as fast as every couple of products.

In fact you perceive that a determination of the proportion in which the substances are present in such a mixture will give us a measure of the relative velocities of those particular atomic motions; and we may thus express our result:—The force of chemical combination is inversely proportional to the number of atomic interchanges.

I cannot quit this part of our subject without alluding to the fact that some few chemists of such eminence as to be entitled to the most respectful attention, have of late years expressed an opinion that the idea of atoms is not necessary for the explanation of the changes in the chemical constitution of matter, and have sought as far as possible to exclude from their language any allusion to atoms.

It would be out of place on this occasion to enter into any discussion of the questions thus raised; but I think it right to point out:—

I. That these objectors have not shown us any inconsistency in the atomic theory, nor in the conclusions to which it leads.

II. That neither these nor any other philosophers have been able to explain the facts of chemistry on the assumption that there are no atoms, but that matter is infinitely divisible.

III. That when they interpret their analyses, these chemists allow themselves neither more nor less latitude than the Atomic Theory allows; in fact they are unconsciously guided by it.

These facts need no comment from me.

Our science grows by the acquisition of new facts which have an intelligible place among our ideas of the order of nature; but in proportion as more and more facts are arranged before us in their natural order, in proportion as our view of the order of nature becomes clearer and broader, we are able to observe and describe that order more fully and more accurately—in fact, to improve our ideas of the order of nature. These more extensive and more accurate ideas suggest new observations, and lead to the discovery of truths which would have found no place in the narrower and less accurate system. Take away from Chemistry the ideas which connect and explain the multifarious facts observed, and it is no longer a science; it is nothing more than a confused and useless heap of materials.

The answer to our question respecting the meaning of the earnest work which is going on in our science must, I think, now be plain to you. Chemists are examining the combining-properties of atoms, and getting clear ideas of the constitution of matter.

Admitting, then, for the present, that such is the meaning of chemical work, we have to consider the more important question of its use; and I think you will agree with me that, in order to judge soundly whether and in what manner such a pursuit is useful, we have to consider its effect upon Man. What habits of mind does it engender? What powers does it develop? Does it develop good and noble qualities and aspirations, and tend

to make men more able and more anxious to do good to their fellow men? Or is it a mere idle amusement, bearing no permanent fruits of improvement?

You will, I think, answer these questions yourselves if I can succeed in describing to you some of the chief qualities which experience has shown to be requisite for the successful pursuit of Chemistry, and which are necessarily cultivated by those who qualify themselves for such a career.

One of the first requirements on the part of an investigator is accuracy in observing the phenomena with which he deals. He must not only see the precise particulars of a process as they present themselves to his observation; he must also observe the order in which these particular appearances present themselves under the conditions of each experiment. No less essential is accuracy of memory. An experimental inquirer must remember accurately a number of facts; and he needs to remember their mutual relations, so that one of them when present to his mind may recall those others which ought to be considered with it. In fact he cultivates the habit of remembering facts mainly by their place in Nature. Accuracy in manual operations is required in all experimental inquiries; and many of them afford scope for very considerable skill and dexterity.

These elementary qualities are well known to be requisite for success in experimental science, and to be developed by careful practice of its methods; but some higher qualities are quite as necessary as these in all but the most rudimentary manipulations, and are developed in a remarkable degree by the higher work of science.

Thus it is of importance to notice that a singularly good training in the accurate use of words is afforded by experimental chemistry. Everyone who is about to enter on an inquiry, whether he be a first-year's student who wants to find the constituents of a common salt, or whether he be the most skilled and experienced of chemists, seeks beforehand to get such information from the records of previous observations as may be most useful for his purpose. This information he obtains through the medium of words; and any failure on his part to understand the precise meaning of the words conveying the information requisite for his guidance is liable to lead him astray. Those elementary exercises in analytical chemistry, in which brief directions to the students alternate with their experiments and their reports of experiments made and conclusions drawn, afford a singularly effective training in the habit of attending accurately to the meaning of words used by others, and of selecting words capable of conveying without ambiguity the precise meaning intended. Any inaccuracy in the student's apprehension of the directions given, or in the selection of words to describe his observations and conclusions, is at once detected, when the result to which he ought to have arrived is known beforehand to the teacher.

Accuracy of reasoning is no less effectively promoted by the work of experimental chemistry. It is no small facility to us that the meaning of the words which we use to denote properties of matter and operations can be learnt by actual observation. Moreover, each proposition comprised in chemical reasoning conveys some distinct statement susceptible of verification by similar means; and the validity of each conclusion can be tested, not only by examining whether or not it follows of necessity from true premises, but also by subjecting it to the independent test of special experiment.

Chemists have frequent occasion to employ arguments which indicate a probability of some truth; and the anticipations based upon them serve as guides to experimental inquiry by suggesting crucial tests. But they distinguish most carefully such hypotheses from demonstrated facts.

Thus a pale green solution, stated to contain a pure metallic salt, is found to possess some properties which belong to salts of iron. Nothing else possesses these except salts of nickel; and they manifest a

slight difference from iron salts in one of the properties observed.

The analyst could not see any appearance of that peculiarity which distinguishes nickel salts; so he concludes that he has probably got iron in his solution, but almost certainly either iron or nickel. He then makes an experiment which will, he knows, give an entirely different result with iron salts and nickel salts; and he gets very distinctly the result which indicates iron.

Having found in the green liquid properties which the presence of iron could alone impart, he considers it highly probable that iron is present. But he does not stop there; for, although the facts before him seem to admit of no other interpretation, he knows that, from insufficient knowledge or attention, mistakes are sometimes made in very simple matters. The analyst therefore tries as many other experiments as are known to distinguish iron salts from all others; and if any one of these leads distinctly to a result at variance with his provisional conclusion, he goes over the whole inquiry again, in order to find where his mistake was. Such inquiries are practised largely by students of chemistry, in order to fix in their minds, by frequent use, a knowledge of the fundamental properties of the common elements, in order to learn by practice the art of making experiments, and, above all, in order to acquire the habit of judging accurately of evidence in natural phenomena. Such a student is often surprised at being told that it is not enough for him to conduct his experiments to such a point that every conclusion except one is contrary to the evidence before him—that he must then try every confirmatory test which he can of the substance believed to be present, and ascertain that the sample in his hands agrees, as far as he can see, in all properties with the known substance of which he believes it to be a specimen.

Those who tread the path of original inquiry, and add to human knowledge by their experiments, are bound to practise this habit with the most scrupulous fidelity and care, or many and grave would be the mistakes they would make.

Thus a chemist thinks it probable that he might prepare some well-known organic body of the aromatic family by a new process. He sets to work and obtains a substance agreeing in appearance, in empirical composition, in molecular weight, and in many other properties with the compound which he had in view. He is, however, not satisfied that his product is a sample of that compound until he has examined carefully whether it possesses all the properties which are known to belong to the substance in question. And many a time is his caution rewarded by the discovery of some distinct difference of melting-point, or of crystalline form, &c., which proves that he has made a new compound isomeric with the one which he expected to make. It seemed probable, from the agreement of the two substances in many particulars, that they might be found to agree in all, and might be considered to be the same compound; but complete proof of that conclusion consists in showing that the new substance agrees with all that we know of the old one.

In the most various ways chemists seek to extend their knowledge of the uniformity of nature; and their reasonings by analogy from particulars to particulars suggest the working hypotheses which lead to new observations. Before, however, proceeding to test the truth of his hypothesis by experiment, the chemist passes in review, as well as he can, all the general knowledge which has any bearing on it, in order to find agreement or disagreement between his hypothesis and the ideas established by past experience. Sometimes he sees that his hypothesis is at variance with some general law in which he has full confidence, and he throws it aside as disproved by that law. On other occasions he finds that it follows of necessity from some known law; and he then proceeds to verify it by experiment, with a confident anticipation of the result. In many cases the hypothesis does not present sufficiently distinct agreement or disagreement with the ideas esta-

blished by previous investigations to justify either the rejection of it or a confident belief in its truth; for it often happens that the results of experience of similar phenomena are not embodied in a sufficiently definite or trustworthy statement to have any other effect than that of giving probability or the contrary to the hypothesis.

Another habit of mind which is indispensable for success in experimental chemistry, and which is taught by the practice of its various operations, is that of truthfulness.

The very object of all our endeavours is to get true ideas of the natural processes of chemical action; for in proportion as our ideas are true they give us the power of directing these processes. In fact our ideas are useful only so far as they are true; and he must indeed be blind to interest and to duty who could wish to swerve from the path of truth. But if any one were weak enough to make the attempt he would find his way barred by innumerable obstacles.

Every addition to our science is a matter of immediate interest and importance to those who are working in the same direction. They verify in various ways the statements of the first discoverer, and seldom fail to notice further particulars, and to correct any little errors of detail into which he may have fallen. They soon make it a stepping-stone to further discoveries. Anything like willful misrepresentation is inevitably detected and made known.

It must not, however, be supposed that the investigator drifts unconsciously into the habit of truthfulness for want of temptation to be untruthful, or even that error presents itself to his mind in a grotesque and repulsive garb, so as to enlist from the first his feelings against it; for I can assure you that the precise contrary of these things happens. Error comes before him usually in the very garb of truth, and his utmost skill and attention are needed to decide whether or not it is entitled to retain that garb.

You will easily see how this happens if you reflect that each working hypothesis employed by an investigator is an unproven proposition, which bears such resemblance to truth as to give rise to hopes that it may really be true. The investigator trusts it provisionally to the extent of trying one or more experiments, of which it claims to predict the specific result. Even though it guide him correctly for a while, he considers it still on trial until it has been tested by every process which ingenuity can suggest for the purpose of detecting a fault.

Most errors which an experimentalist has to do with are really imperfect truths, which have done good service in their time by guiding the course of discovery. The great object of scientific work is to replace these imperfect truths by more exact and comprehensive statements of the order of nature.

Whoever has once got knowledge from Nature herself, by truthful reasoning and experiment, must be dull indeed if he does not feel that he has acquired a new and noble power, and if he does not long to exercise it further, and make new conquests from the realm of darkness by the aid of known truths.

The habit of systematically searching for truth by the aid of known truths, and of testing the validity of each step by constant reference to nature, has now been practised for a sufficiently long time to enable us to judge of some of its results.

Every true idea of the order of nature is an instrument of thought. It can only be obtained by truthful investigation, and it can only be used effectively in obedience to the same laws. But the first idea which is formed of anything occurring in nature affords only a partial representation of the actual reality, by recording what is seen of it from a particular point of view. By examining a thing from different points of view we get different ideas of it; and when we compare these ideas accurately with one another, recollecting how each one was obtained, we find that they really supplement each other.

We try to form in our minds a distinct image of a thing

capable of producing these various appearances; and when we have succeeded in doing so, we look at it from the different points of view from which the natural object had been examined, and find that the ideas so obtained meet at the central image. It usually happens that an accurate examination of the mutual bearings of these ideas on the central image suggests additions to them, and correction of some particulars in them.

Thus it is that true ideas of a natural phenomenon confirm and strengthen one another, and he who aids directly the development of one of them is sure to promote indirectly the consolidation of others.

Each onward step in the search for truth has made us stronger for the work; and when we look back upon what has been done by the efforts of so many workers simply but steadily directed by truth towards further truth, we see that they have achieved, for the benefit of the human race, the conquest of a systematic body of truths which encourages men to similar efforts while affording them the most effectual aid and guidance.

This lesson of the inherent vitality of truth, which is taught us so clearly by the history of our science, is well worthy of the consideration of those who, seeing that iniquity and falsehood so frequently triumph for a while in the struggle for existence, are inclined to take a desponding view of human affairs, and almost to despair of the ultimate predominance of truth and goodness. I believe it would be impossible, at the present time, to form an adequate idea of the vast consequences which will follow from the national adoption of systematic measures for allowing our knowledge of truth to develop itself freely, through the labours of those who are willing and able to devote themselves to its service, so as to strengthen more and more the belief and trust of mankind in its guidance, in small matters as well as in the highest and most important considerations.

I am desirous of describing briefly the more important of those measures; but first let me mention another habit of mind which naturally follows from the effective pursuit of truth,—a habit which might be described in general terms as the application to other matters of the truthfulness imparted by science.

The words which the great German poet put into the mouth of Mephistopheles, when describing himself to Faust, afford perhaps the most concise and forcible statement of what we may call the anti-scientific spirit:—

"Ich bin der Geist der stets verneint,
Dem alles, was entsteht, zuwider ist."

The true spirit of science is certainly affirmative, not negative, for, as I mentioned just now, its history teaches us that the development of our knowledge usually takes place through two or more simultaneous ideas of the same phenomenon, quite different from one another, both of which ultimately prove to be parts of some more general truth: so that a confident belief in one of those ideas does not involve or justify a denial of the others.

I could give you many remarkable illustrations of this law from among ideas familiar to chemists. But I want you to consider with me its bearing on the habit of mind called toleration, of which the development in modern times is perhaps one of the most hopeful indications of moral improvement in man.

In working at our science we simply try to find out what is true; for although no usefulness is to be found at first in most of our results, we know well that every extension of our knowledge of truth is sure to prove useful in manifold ways. So regular an attendant is usefulness upon truth in our work, that we get accustomed to expect them always to go together, and to believe that there must be some amount of truth wherever there is manifest usefulness.

The history of human ideas, so far as it is written in the records of the progress of science, abounds with instances of men contributing powerfully to the development of important general ideas, by their accurate and conscientious experiments, while at the same time pro-

fessing an actual disbelief in those ideas. Those records must indeed have been a dead letter to any who could stand carping at the intellectual crotchets of a good and honest worker, instead of giving him all brotherly help in the furtherance of his work.

To one who knows the particulars of our science thoroughly, and who knows also what a variety of ideas have been resorted to in working out the whole body of truths of which the science is composed, there are few more impressive and elevating subjects of contemplation than the unity in the clear and bold outline of that noble structure.

I hope that you will not suppose, from my references to Chemistry as promoting the development of these habits and powers of mind, that I wish to claim for that particular branch of science any exclusive merit of the kind, for I can assure you that nothing can be further from my intention.

I conceived that you would wish me to speak of that department of science which I have had occasion to study more particularly; but much that I have said of it might be said with equal truth of other studies, while some of its merits may be claimed in a higher degree by other branches of science. On the other hand, those highest lessons which I have illustrated by chemistry are best learnt by those whose intellectual horizon includes other provinces of knowledge.

Chemistry presents peculiar advantages for educational purposes in the combination of breadth and accuracy in the training which it affords; and I am inclined to think that in this respect it is at present unequalled. There is reason to believe that it will play an important part in general education, and render valuable services to it in conjunction with other scientific and with literary studies.

(To be continued.)

Section B.

ADDRESS

TO THE

CHEMICAL SECTION.

SEPTEMBER 18, 1873.

By W. J. RUSSELL, Ph D. F.R.S.,
President of the Section.

LADIES AND GENTLEMEN,—

Of late years it has been the custom of my predecessors in this chair to open the business of the Section with an address, and the subject of this address has almost invariably been a review of the progress of Chemistry during the past year: I purpose, with your leave, to-day to deviate somewhat from this precedent, and to limit my remarks, as far as the progress of Chemistry is concerned, to the history of one chemical substance. The interest and the use of an annual survey at these meetings of the progress of Chemistry has to a certain extent passed away; for the admirable abstracts of all important chemical papers now published by the Chemical Society has, in a great measure, taken its place, and offers to the chemical student a much more thorough means of learning what progress his science is making than could possibly be done by the study of a presidential address. Doubtless these abstracts of chemical papers are known to others than professional chemists; but I cannot pass them over without recording the great use they have proved to be, how much they have done already in extending in this country an exact knowledge of the progress of science on the Continent, and in helping and in stimulating those who are engaged in scientific pursuits in this country. I believe few grants made by this Association have done more real good than those which have enabled the Chemical Society to publish these abstracts.

I dwell for a moment on the doings of the Chemical Society, for I believe in the progress of this Society we

have a most important indication of the progress of chemical science in this country. The number of original papers communicated to the Society during the last year has far exceeded that of previous years; during last year fifty-eight papers were read to the Society, whereas the average number for the last three years is only twenty-nine. Further, I may say there is every appearance of this increased activity not only continuing but even increasing. Another matter connected with the Society deserves a passing word: I mean its removal from its old rooms at Burlington House, which afforded it very insufficient accommodation, to its new ones in the same building. This transference, which is now taking place, will give to the Society a great increase of accommodation, and thus admit of larger audiences attending the lectures, of the proper development of the library, and of the full illustration, by experiment, of the communications made to it. These improvements must act most beneficially on the Society, and stimulate its future development: even now it numbers some 700 members, and certainly is not one of the least active or least useful of the many scientific societies in London.

Since our last Meeting at Brighton we have lost the most renowned of modern chemists, Liebig. His influence on chemistry through a long and most active life has yet to be written. Publishing his first paper fifty years ago, it is difficult for chemists of the present day to realise the changes in chemical thought, in chemical knowledge, and in chemical experiment which he lived through, and was, more than any other chemist, active in promoting. His activity was unwearied; he communicated no less than 317 papers to different scientific journals, and almost every branch of chemistry received some impetus from his hand.

Liebig took an active interest in this Association, and I believe the last paper he wrote was one in answer to a communication made at the last Meeting of this Association. On two occasions he attended Meetings of the British Association, and has communicated many papers to this Section. The Meeting at Liverpool in 1837 was the first at which he was present; he then communicated to this Section a paper on the products of the decomposition of Uric Acid, and, further, gave an account of his most important discovery, made in conjunction with Wöhler, of the artificial formation of Urea. At this Meeting Liebig was requested to prepare a report on the state of our knowledge of isomeric bodies. This request, although often repeated, was never complied with. He was also requested to report on the state of Organic Chemistry and Organic Analysis: thus our Section was evidently desirous of giving him full occupation. At the Meeting in 1840, at Glasgow, a paper on Poisons, Contagions, and Miasms, by Liebig, was read; it was, in fact, an abstract of the last chapter in his book on Chemistry in its applications to Agriculture and Physiology; and the work itself appeared about the same time, dedicated to this Association. In his dedication Liebig says:—"At one of the meetings of the Chemical Section of the British Association for the Advancement of Science, the honourable task of preparing a Report upon the State of Organic Chemistry was imposed upon me. In this present work I present the Association with a part of this Report."

At the next Meeting, which was at Plymouth, in 1841, there was an interesting letter from Liebig to Dr. Playfair, read to our Section; in it, among other matters, Liebig describes an "excellent method," devised by Drs. Will and Varrentrapp, for determining the amount of nitrogen in organic bodies: he also says we have repeated all the experiments of Dr. Brown on the production of silica from paracyanogen, but we have not been able to confirm one of his results; what our experiments prove is, that paracyanogen is decomposed by a strong heat into nitrogen gas and a residue of carbon, which is exceedingly difficult of combustion.

To the next Meeting (which was at Manchester, and

Dalton was the President of this Section) Dr. Playfair communicated an abstract of Prof. Liebig's report on Organic Chemistry applied to Physiology and Pathology: this abstract is printed in our *Proceedings*, and the complete work is looked upon as the second part of the report on Organic Chemistry. This Association may therefore fairly consider that it exercised some influence on Liebig in the production of the most important works that he wrote. Playfair's abstract must have been listened to with the greatest interest, and I doubt not the statements made were sharply criticised, especially by the physiologists then at Manchester. Playfair concludes his abstract in these words, thus summing up the special objects of these reports:—"In the opinion of all, Liebig may be considered a benefactor to his species for the interesting discoveries in agriculture published by him in the first part of this report. And having in that pointed out means by which the food of the human race may be increased, in the work now before us he follows up the chain in its continuation, and shows how that food may best be adapted to the nutrition of man. Surely there are no two subjects more fitted than these for the contemplation of the philosopher; and by the consummate sagacity with which Liebig has applied to their elucidation the powers of his mind, we are compelled to admit that there is no living philosopher to whom the Chemical Section could have more appropriately entrusted their investigation."

At the Meeting at Glasgow in 1855 Liebig was also present, but he then only communicated to this Section a short paper on fulminic acid, and some remarks on the use of lime-water in the manufacture of bread.

Such, I believe, is the history of the direct relationship which has existed between Liebig and this Association. Indirectly we can hardly recognise how much we owe to him. Interested as he ever was in the work of this Association, I could not but to-day record the instances of direct aid and support which this Section has received from him.

I pass on now to the special subject to which I wish to ask your attention. It is the history of the vegetable colouring matter found in madder: it has been in use from time immemorial, and is still one of the commonest and most important of dyes: it is obtained from a plant largely cultivated in many parts of the world for the sake of the colour it yields; and the special interest which now attaches to it is that the chemist has lately shown how this natural colouring matter can be made in the laboratory as well as in the fields—how by using a by-product which formerly was without value, thousands of acres can be liberated for the cultivation of other crops, and the colouring matter which they formerly produced be cheaper and better prepared in the laboratory or in the manufactory. That a certain colouring matter could be obtained from the roots of the *Rubia tinctorum* and other species of the same plant has been so long known that apparently no record of its discovery remains. Pliny and Dioscorides evidently allude to it. The former, referring to its value as a dyeing material, says—"It is a plant little known, except to the sordid and avaricious; and this because of the large profits obtained from it, owing to its employment in dyeing wool and leather." He further says—"The madder of Italy is the most esteemed, and especially that grown in the neighbourhood of Rome, where and in other places it is produced in great abundance." He further describes it as being grown among the olive-trees, or in fields devoted especially to its growth. The madder of Ravenna, according to Dioscorides, was the most esteemed. Its cultivation in Italy has been continued till the present time, and in 1863 the Neapolitan provinces alone exported it to the value of more than a quarter of a million sterling. At the present day we are all very familiar with this colouring matter as the commonest that is applied to calicoes: it is capable of yielding many colours, such as red, pink, purple, chocolate, and black. The plant which is the source of this colouring matter is nearly allied, botanically and in ap-

pearance, to the ordinary *Galium* or bedstraws. It is a native probably of Southern Europe, as well as Asia. It is a perennial, with herbaceous stem, which dies down every year; its square-jointed stalk creeps along the ground to a considerable distance, and the stem and leaves are rough, with sharp prickles. The root, which is cylindrical, fleshy, and of a pale yellow colour, extends downwards to a considerable depth: it is from this root (which, when dried, is known as madder) that the colouring matter is obtained. The plant is propagated from suckers or shoots; these require some two or three years to come to full maturity and yield the finest colours, although in France the crop is often gathered after only eighteen months' growth. From its taking so long to develop, it is evidently a crop not adapted to any ordinary series of rotation of crops. The plant thrives best in a warm climate, but has been grown in this country and in the north of Europe.

In India it has been grown from the earliest times, and, as before stated, has been abundantly cultivated in Italy certainly since the time of Pliny; he also mentions its cultivation in Galilee. In this country its culture has often been attempted, and has been carried on for a short time, but never with permanent success. The madder now used in England is imported from France, Italy, Holland, South Germany, Turkey, and India. In 1857 the total amount imported into this country was 434,056 cwts., having an estimated value of £1,284,989; and the average annual amount imported during the last seventeen years is 310,042 cwts., while the amount imported last year (1872) was 283,274 cwts., valued at £922,244. In 1861 it was estimated that in the South Lancashire district alone 150 tons of madder were used weekly, exclusive of that required for preparing garancin. I quote these figures as showing the magnitude of the industry that we are dealing with. Another point of much interest is the amount of land required for the cultivation of this plant: in England it was found that an acre yielded only from 10 to 20 cwts. of the dried roots, but in South Germany and in France the same amount of land yields about twice that quantity. The madder cultivator digs up the roots in autumn, dries them, in some cases peels them by beating them with a flail, and exports them in the form of powder, whole root, or after treatment with sulphuric acid, when it is known as garancin.

The quality of the root varies much; that from the Levant, and known as Turkey-root, is most valued. According, however, to the colour to be produced is the madder from one source or another preferred. To obtain the colouring matter, which is but very slightly soluble in water, from these roots, they are mixed, after being ground, with water in the dye-vessel, and sometimes a little chalk is added. The fabric to be dyed is introduced, and the whole slowly heated; the colouring matter gradually passes from the root to the water, and from the water to the mordanted fabric, giving to it a colour dependent of course on the nature of the mordant.

To trace the chemical history of this colouring matter we have to go back to the year 1790, when a chemist of the name of Watt precipitated the colouring matter of madder by alum from neutral, alkaline, and acid solutions; he obtained two different colouring matters, but could not isolate them, and many different shades of colour. Charles Bartholomew asserted that madder contained much magnesia sulphate, and Hausmann observed the good effect produced on madder by the addition of calcic carbonate. In 1833 F. Kuhlmann made evidently a careful analysis of the madder root, and describes a red and a fawn colouring matter; but the first really important advance made in our knowledge of the chemical constitution of this colouring matter was by Colin and Robiquet in 1827; they obtained what they believed to be, and what has since really proved to be, the true colouring principle of madder, and obtained it in a state of tolerable purity. Their process for preparing it was very simple: they took Alsace madder in powder, digested it with water, obtained thus a gelatinous mass,

which they treated with boiling alcohol, then evaporated off four-fifths of the alcohol, and treated the residue with a little sulphuric acid to diminish its solubility; then, after washing it with several litres of water, they got a yellowish substance remaining. Lastly, they found that, on moderately heating this product in a glass tube, they obtained a yellowish vapour formed of brilliant particles, which condensed, giving a distinct zone of brilliant needles, reflecting a colour similar to that from the native lead chromate. They named this substance alizarin, from the Levant name for madder, *alizari*, the name by which it is still known there.

A few years later we find other chemists attacking this same subject. In 1831, Gaultier de Claubury and J. Persoz published the account of a long research on the subject; they describe two colouring matters, a red and a rose one: the red one was alizarin, and the rose one was another body nearly allied to it, and now well-known as purpurin. Runge also made an elaborate examination of the madder-root; he found no less than five different colouring matters in it—madder-red, madder-purple, madder-orange, madder-yellow, and madder-brown. The first three he considers to be suited for dyeing purposes, but not so the last two. Runge's madder-red is essentially impure alizarin, and his madder-purple impure purpurin. He does not give any analysis of these substances.

During the next ten years this subject seems to have attracted but little attention from chemists; but in 1846 Shiel prepared the madder-red and madder-purple of Runge, by processes very similar to those employed by Runge, and analysed these substances: for madder-red he gives the formula $C_{25}H_{15}O_9$, which differs only by H_2O from the formula now adopted; for the madder-purple he gives the formula $C_{25}H_{15}O_{15}$, and for the same substance after being sublimed $C_7H_5O_4$. The chemist who has worked most on this subject, and to whom we are principally indebted for what we know with regard to the different constituents contained in the madder-root, is Dr. Schunck, of Manchester. In Liebig's "Annalen" for 1848 he gives a long and interesting account of his examination of madder; he isolates and identifies several new substances, which are most important constituents of the root, and has since that time added much to our knowledge of the chemical constitution of madder. In the paper above alluded to he confirms the presence of the alizarin, and gives to it the formula $C_{14}H_{10}O_4$. The principal properties of this body may best be sketched in here. Its volatility and brilliant crystalline appearance have already been mentioned; it is but slightly soluble in cold water, but much more so in alcohol, in ether, and in boiling water. The colour of its solution is yellow; and when it separates out from a liquid it has a yellow flocculent appearance, differing thus greatly from the red brilliant crystalline substance before described. In order to obtain this latter body, heat had always been used; so, until the elaborate experiments of Schunck, it was a question whether the heat did not produce a radical change in the substance, whether, in a word, these two bodies were really identical. Schunck's experiments proved that they were, and consequently that this beautiful colouring matter, alizarin, existed as such in madder. If, however, we go one step further back, and examine the fresh root of the *Rubia tinctorum* (that is, as soon as it is drawn from the ground), we shall find no trace of alizarin there. On slicing the root it is seen to be of a light carrot colour, and an almost colourless liquid can be squeezed out of it; but this is entirely free from the colouring matters of madder. Let the roots, however, be kept, if only for a short time, and then they will give abundant evidence of the presence of alizarin: if simply heated, alizarin may be volatilised from them. It appears, then, that the whole of the tinctorial power of this root is developed after the death of the plant. Schunck explains this curious phenomenon as follows:—In the cells of the living plant there is a substance which he has isolated and has named rubian; it is easily soluble in water and in alcohol; the

solution is of a yellow colour, and has an intensely bitter taste; when dry, it is a hard brown gum-like body. It has none of the properties of a dye-stuff; but if we take a solution of it, add some sulphuric or hydrochloric acid to it, and boil, a yellow flocculent substance will slowly separate out, and, on filtering it off and washing it, it will be found to have the tinctorial properties of madder, and to contain alizarin. In the liquid filtered from it there is, with the acid added, an uncrystallisable sugar; so that in this way the original product in the root, the rubian, has apparently been split up into alizarin and into sugar. To apply this reaction to what goes on in the root after its removal from the ground, we have to find if any other substances can take the place of the boiling dilute acid; and Schunck has shown there exists in the root itself a substance which is eminently fitted to produce this splitting-up of the rubian. He obtained this decomposing agent from madder simply by digesting it in cold water and adding alcohol to the liquid; this threw down a reddish flocculent substance; and, if only a small portion of this was added to an aqueous solution of the rubian, and allowed to stand for a few hours in a warm place, it was found that the rubian was gone, and in place of it there was a thick tenacious jelly; this, treated with cold water, gave to it no colour, no bitter taste, but much sugar. From the jelly remaining insoluble, alizarin could be extracted; in fact, of all known substances this very one found in the madder itself is best suited for effecting this decomposition of the rubian.

It has long been known to dyers that the amount of colouring matter in madder will increase on keeping it; even for years it will go on improving in quality: and an experiment of Schunck's shows that the ordinary madder, as used by the dyer, has not all the rubian converted into colouring matter; for, on taking a sample of it and extracting it with cold water, he got an acid solution devoid of dyeing properties; but, on allowing this solution to stand some time, it gelatinised, and then possessed dyeing properties.

It appears, then, that there must exist in the root two substances kept apart during the life of the plant in some way of which we know nothing; but as soon as it dies they begin slowly to act on one another, developing thus the colouring matters in madder.

Coincident with the appearance of Schunck's first paper was one by Debus on the same subject: he looked upon alizarin as a true acid, and gave it the name of lizaric acid; but, as far as the composition of it was concerned, the percentage numbers he obtained agreed closely with those given by Schunck. One other investigation concludes all that is important in the history of alizarin as obtained from madder. This last investigation is of great interest; it was by Julius Wolff and Adolphe Strecker, and published in 1850; they confirm the results of others so far that there are in the madder-root two distinct colouring substances—this important one alizarin, and the other one purpurin. They prepare these colouring matters much in the same way that Schunck did, and very carefully purify and analyse them: the formulæ which they give for them differ, however, from Schunck's; for alizarin they give the formula $C_{20}H_{12}O_6$, and for purpurin $C_{18}H_{12}O_6$. Further, they suggest that, by the process of fermentation, the former is converted into the latter, and they show that by oxidation they both yielded phthalic acid. Since the publication of this research, until the last year or two, this formula for alizarin has been generally adopted by chemists, and in most modern books we find it given as expressing the true composition of that body. It was not only the careful and elaborate work which they devoted to the subject, but also the ingenious and apparently well-founded theory on the subject, which carried conviction with it. Laurent had shown, not many years before, that when naphthalin, that beautiful and white crystalline substance obtained from coal-tar, was acted on by chlorine, and then treated with nitric acid, a body, known as chlornaphthalic acid, and having the composition

$\text{C}_{20}\text{H}_{10}\text{Cl}_2\text{O}_6$, was obtained; and, on comparing this formula with the one they had obtained for alizarin, Wolff and Strecker at once concluded that it really was alizarin, only containing 2 atoms of chlorine in place of 2 of hydrogen; make this replacement, an operation generally easily performed, and from naphthalin they had prepared alizarin. Further, this relationship between chlor-naphthalic acid and alizarin is borne out in many ways; i.e., like alizarin, has the power of combining with different basic substances, has a yellow colour, is insoluble in water, melts at about the same temperature, is volatile, and when acted on by alkalis gives a strongly coloured solution. Taking, then, all these facts into consideration, can we wonder that these chemists feel convinced that they have established the composition of alizarin, and have shown the source from which it is to be obtained artificially? Apparently but one very simple step remains to crown their work with success, that of replacing the chlorine by hydrogen. Melsens had only shortly before shown how this substitution could easily be made in the case of chloracetic acid, by adding on it with potassium amalgam; and Kolbe had used the battery for the same purpose: both these processes, and doubtless all others that the authors can think of, are tried upon the chlor-naphthalic acid; but chlor-naphthalic acid it remains, and they are obliged to confess they are unable to make this substitution; still they are strong in the belief that it is to be done and will be done, and conclude the account of their researches by pointing out the great technical advantage it will be getting alizarin from a worthless substance such as naphthalin. One cannot help even now sympathising with these chemists in their not being able to confirm what they had really the strongest evidence for believing must prove to be a great discovery. We now know, however, that had they succeeded in effecting this substitution, or had they in any other way obtained this chlor-naphthalic acid without the chlorine, if I may so speak of it, which since their time has been done by Martius and Griess, alizarin would not have been obtained, but a body having a remarkable parallelism in properties to it would have been. This body, like alizarin, is of a yellowish colour, but slightly soluble in water, easily in alcohol and in ether, is volatile, and on oxidation yields the same products; it is, in fact, an analogous body, but belonging to another group. We also now know that the formula proposed by Wolff and Strecker, and so long in use, is not the correct one. But little more remains to be added with regard to the history of alizarin, as gathered from the study of the natural substance. Schützenberger and Paraf suggested doubling Wolff and Strecker's formula for alizarin; and Bolley suggested the formula $\text{C}_{20}\text{H}_{13}\text{O}_6$, which, owing to the uneven number of hydrogen atoms, was soon rejected. If we compare our present knowledge of alizarin with what it was when these researches on the natural product were completed, it is as lightness compared to darkness; and we may well ask, whence has come this influx of knowledge? The answer, I hope to show you, is undoubtedly that it has come from the careful and accurate study of abstract chemistry. I know of no history in the whole of chemistry which more strikingly illustrates how the prosecution of abstract science lays the foundation for great practical improvements than the history of alizarin does.

My object now is, then, to show you, as shortly as I can, how by indirect means the composition of alizarin was discovered, how it has been built up artificially, and how it is superseding for manufacturing purposes the long-used natural product.

To trace this history from its source we must go back to 1785, when an apothecary of the name of Hofmann obtained the calcium salt of an acid called quinic acid from Cinchona bark. This acid is now known to be of common occurrence in plants; it exists in the bilberry and in coffee, in holly, ivy, oak, elm, and ash leaves, and probably many other leaves. Liebig also prepared the calcium salt, and was the first to give a complete analysis

of it; the formula he gave for it was $\text{C}_{12}\text{H}_{24}\text{O}_{12}$. Baup, on repeating Liebig's experiments, arrived at a somewhat different conclusion, and gave the formula $\text{C}_{13}\text{H}_{26}\text{O}_{12}$. In 1835, at Liebig's suggestion to determine which formula was correct, Alexander Woskrensky, from St. Petersburg, then a student at Giessen, undertook the further investigation of this subject, and established the formula $\text{C}_{14}\text{H}_{24}\text{O}_{12}$, the one in fact now in use. In the course of this investigation, which he carried further than merely settling the percentage composition of this acid, he describes what to us now is of most interest, a new substance having peculiar and very marked properties. He says that when a salt of quinic acid is burnt at a gentle heat he gets aqueous vapour, the vapour of formic acid, and a deposit of golden needles, which are easily sublimed; afterwards he describes how this same golden substance may be obtained from any salt of quinic acid by heating it with manganic dioxide and dilute sulphuric acid; it then distils over, condensing in golden-yellow needles on the sides of the receiver, and may be rendered pure by re-sublimation. The composition of this body he finds to be $\text{C}_{11}\text{H}_{10}$, and names it quinoyl, a name strongly objected to by Berzelius, as conveying a wrong impression of the nature of the body; he proposed in place of it the name quinone, by which it is still known. Far as this body would seem to be removed from alizarin, yet it is the study of its properties which led to the artificial production of alizarin.

Some years afterwards Wöhler also examined the decomposition of quinic acid; he prepares again this quinone, and follows exactly the process described by Woskrensky; he states that, with regard to the properties of this remarkable body, he has nothing particular to add; however, he proposes a different formula for it, and discovers and describes other bodies allied to it; among these is hydroquinone, $\text{C}_6\text{H}_6\text{O}_2$. Laurent afterwards shows that the formula proposed by Wöhler is inconsistent with his and Gerhardt's views, and by experiment confirms the former formula for this body. Although many other chemists devoted much attention to this substance, still its real constitution and relation to other compounds remained long unknown. Thus Wöhler, Laurent, Hofmann, Städeler, and Hesse all had worked at it, and much experimental knowledge with regard to it had been acquired. One important point in its history was, first, the discovery of chloranil by Erdmann in 1841, and then Hofmann showing that by heating quinone with potassic chlorate and hydrochloric acid, chloranil could be obtained from it—that, in fact, chloranil was quinone in which all the hydrogen had been replaced by chlorine. Perhaps the most general impression among chemists was, that in constitution it was a kind of aldehyd; certainly its definite place among chemical compounds was not known. Kekulé suggests a rational formula for it; but it is to Carl Gräbe that we owe our knowledge of its true constitution. In 1868 he published a remarkable and very able paper on the quinone group of compounds, and then first brought forward the view that quinone was a substitution derivative of the hydrocarbon benzol (C_6H_6). On comparing the composition of these two bodies, it is seen that the quinone contains 2 atoms of oxygen more, and 2 atoms of hydrogen less, than benzol; and Gräbe, from the study of the decomposition of quinone and from the compounds it forms, suggested that the 2 atoms of oxygen form in themselves a group which is divalent, and thus replace the two atoms of hydrogen; this supposition he very forcibly advocates, and shows its simple and satisfactory application to all the then known reactions of this body. This suggestion really proved to be the key, not only to the explanation of the natural constitution of quinone and its derivatives, but to much important discovery besides.

At this time quinone seemed to stand alone, no other similarly constituted body was known to exist; but what strikingly confirms the correctness of Gräbe's views, and indicates their great value, is that immediately he is able

to apply his lately gained knowledge, and to show how really other analogous bodies, other quinones in fact, already exist. He studied with great care this quinone series of compounds and the relation they bore to one another—the relation the hydrocarbon benzol bore to its oxidised derivative quinone, and its relation to the chlorine substitution-products derivable from it. At once this seems to have led Gräbe to the conclusion that another such series already existed ready formed, and that its members were well known to chemists—that, in fact, naphthalin ($C_{10}H_8$) was the parent hydrocarbon, and that the chloroxynaphthalin chloride ($C_{10}H_4Cl_2O_2$) and the perchloroxynaphthalin chloride ($C_{10}H_2Cl_6O_2$) were really chlorine substitution-compounds of the quinone of this series, corresponding to the dichloroquinone and to chloranil—that the chloroxynaphthalic acid, $C_{10}H_4Cl(HO)O_2$, and the perchloroxynaphthalic acid, $C_{10}H_2Cl_3(HO)O_2$, all compounds previously discovered by Laurent, were really bodies belonging to this series—and, further, that the supposed isomer of alizarin discovered by Martius and Griess was really related to this last compound, having the composition $C_{10}H_2(HO)O_2$. Further, he was able to confirm this by obtaining the quinone itself of this series, the body having the formula $C_{10}H_6(O_2)$, containing also 2 atoms less of hydrogen and 2 atoms more of oxygen than the hydrocarbon naphthalin; and to this body he gave the characteristic name of naphthoquinone. The chlorine compounds just named are, then, chloranaphthoquinones or chloroxynaphthoquinones, and correspond to the former chloroquinones; and Martius and Griess's compound will be an oxynaphthoquinone: many other compounds of this series are also known. Another step confirmatory of this existence of a series of quinones was made by Gräbe and Bergmann: as the chloranil could be found by treating phenol with potassic chlorate and hydrochloric acid, and quinone derived from it, they showed that in the next higher series to the phenol series, viz., with cresol, the same reaction held good; and by treating it in the same way, they obtained a di- and a trichloroquinone—

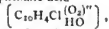


which in physical properties very closely resembled the corresponding compounds in the lower series: other compounds have also been prepared.

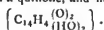
In the next step we have the application which connects these series of discoveries with alizarin. Following the clue of a certain analogy which they believed to exist between the chloranilic acid—



and the chloroxynaphthalic acid—



which they had proved to be quinone compounds and alizarin, believing that a certain similarity of properties indicated a certain similarity of constitution, Gräbe and Liebermann were led to suppose that alizarin must also be a derivative from a quinone, and have the formula—



This theory they were able afterwards to prove. The first thing was to find the hydrocarbon from which the quinone might be derived. This was done by taking alizarin itself and heating it with a very large excess of zinc powder in a long tube closed at one end. A product distilled over, and condensed in the cool part of the tube. On collecting it and purifying it by re-crystallisation, they found they had not a new substance, but a hydrocarbon discovered as long ago as 1832 by Dumas and Laurent, and obtained by them from tar. They had given it the formula $C_{15}H_{12}$; and as apparently it thus contained once and a half as many atoms of carbon and hydrogen as

naphthalin did, they named it paranaphthalin. Afterwards Laurent changed its name to anthracen, by which it is still known. Fritzsche, in 1857, probably obtained the same body, but gave it the formula $C_{14}H_{10}$. Anderson also met with it in his researches, established its composition, and formed some derivatives from it. Limpricht in 1866 showed it could be formed synthetically by heating benzol chloride (C_6H_5Cl) with water; and Berthelot has since proved that it is formed by the action of heat on many hydrocarbons. This first step was then complete and most satisfactory; from alizarin they had obtained its hydrocarbon, and this hydrocarbon was a body already known, and with such marked properties that it was easy to identify it. But would the next requirement be fulfilled? Would it, like benzol and naphthalin, yield a quinone? The experiment had not to be tried; for when they found that anthracen was the hydrocarbon formed, they recognised in a body already known the quinone derivable from it. It had been prepared by Laurent by the action of nitric acid on anthracen, and called by him Anthracenone; and the same substance was also discovered by Anderson, and called by him Oxanthracen. The composition of this body was proved by Anderson and Laurent to be $C_{14}H_8O_2$, and thus bears the same relation to its hydrocarbon anthracen that quinone and naphthoquinone do to their hydrocarbons. Gräbe gave to it the systematic name of Anthraquinone.

We have then now three hydrocarbons— C_6H_6 , $C_{10}H_8$, and $C_{14}H_{10}$ —differing by C_4H_2 , and all forming starting-points for these different quinone series. Anthraquinone, acted upon by chlorine, gave substitution-products such as might have been foretold. It is an exceedingly stable compound, not acted upon even by fusion with potassic hydrate. Bromine does not act upon it in the cold, but at 100° it forms a dibromanthraquinone. Other bromine compounds have also been formed.

Now, if the analogies which have guided them so far still hold good, they would seem to have the means of forming alizarin artificially. Their theory is that it is dioxyanthraquinone—



and if so, judging from what is known to take place with other quinone derivatives, should be formed from this dibromanthraquinone on boiling it with potash or soda and then acidulating the solution. They try the experiment, and describe how, contrary at first to their expectation, on boiling dibromanthraquinone with potash no change occurred; but afterwards, on using stronger potash and a higher temperature, they had the satisfaction of seeing the liquid little by little become of a violet colour. This shows the formation of alizarin. Afterwards, on acidifying this solution, the alizarin separated out in yellowish flocks. On volatilising it they get it in crystals like those obtained from madder; on oxidising it with nitric acid, they get phthalic acid; and on precipitating it with the ordinary mordants or other metallic solutions, they get compounds exactly comparable to those from the natural product. Every trial confirms their success; so, by following purely theoretical considerations, they have been led to the discovery of the means of artificially forming this important organic colouring matter. A special interest must always attach itself to this discovery, for it is the first instance in which a natural organic colouring matter has been built up by artificial means. Now the chemist can compete with nature in its production. Although the first, it is a safe prediction that it will not long be the only one. Which colouring matter will follow next it is impossible to say; but, sooner or later, that most interesting one, scientifically and practically indigo, will have to yield to the scientific chemist the history of its production.

Returning for a moment to the percentage composition of alizarin, now that we know its constitution, its formula is established; and on comparing it ($C_{14}H_6O_2$) with all the different formulæ which have been proposed, we see

that the one advocated by Schunck was most nearly correct—in fact, that it differs from it only by 2 atoms of hydrogen. It is not without interest to note that the next most important colouring matter in madder, purpurin, which so pertinaciously follows alizarin, is in constitution very nearly allied to it, and is also an anthracene derivative.

Scientifically, then, the artificial production of this natural product was complete; but the practical question, Can it be made in the laboratory cheaper than it can be obtained from the root? had yet to be dealt with. The raw material, the anthracene, a by-product in the manufacture of coal-gas, had as yet only been obtained as a chemical curiosity; it had no market value; its cost would depend on the labour of separating it from the tar and the amount obtainable. But with regard to the bromine necessary to form the bibromanthraquinone it was different; the use of such an expensive reagent would preclude the process becoming a manufacturing one. But could no cheaper reagent be used in place of the bromine, and thus crown this discovery by utilising it as a manufacturing process? It was our countryman Mr. Perkin who first showed how this could be done, and has since proved the very practical and important nature of his discovery by carrying it out on the manufacturing scale. The nature of Perkin's discovery was the forming, in place of a bibromanthraquinone, a disulphoanthraquinone; in a word, he used sulphuric acid in place of bromine, obtaining thus a sulpho-acid in place of a bromine substitution-compound. The properties of these sulpho-acids, containing the monovalent group HSO_3 , which is the equivalent to the atom of bromine, is that on being boiled with an alkali they are decomposed, and a corresponding alkaline salt formed. Thus the change from the anthraquinone to the alizarin was effected by boiling it with sulphuric acid. At a high temperature it dissolves, becoming a sulpho-acid—



and then the further changes follow, as they did with the bromine compound. The sulpho-acid boiled with potash is decomposed, and a potash salt of alizarin and potassic sulphate are formed; acid then precipitates the alizarin as a bright yellow substance.

While Perkin was carrying on these researches in this country, Caro, Gräbe, and Liebermann were carrying on somewhat similar ones in Germany; and in both countries have the scientific experiments developed into manufacturing industries. My knowledge extends only to the English manufactory; and if any excuse be necessary for having asked your attention to-day to this long history of a single substance, I think I must plead the existence of that manufactory as my excuse; for it is not often that purely scientific research so rapidly culminates in great practical undertakings. Already has the artificial become a most formidable opponent to the natural product; and in this struggle, already begun, there can be no doubt which will come off victorious.

In the manufactory is rigidly carried out the exact process I have already described to you. In tar there is about 1 per cent of anthracene; this, in a crude impure state, is obtained from it by the tar-distiller and sent by him to the colour works. Here it is purified by pressure, by dissolving from it many of its impurities, and, lastly, by volatilising it. Then comes the conversion of it into the anthraquinone by oxidising agents, nitric or chromic acid being used, then the formation of the sulpho-compound by heating it with sulphuric acid to a temperature of about 260°C . The excess of acid present is then neutralised by the addition of lime, and the insoluble calcic sulphate is filtered off. To the filtered liquid sodic carbonate is added, and thus the calcic salt of the sulpho-acid is changed into the sodic salt—



This is afterwards heated to about 180°C . with caustic soda, thus decomposing the sulpho-acid and forming the soda salt of alizarin and the sodic sulphite. The alizarin salt so formed remains in solution, giving to the liquid a beautiful violet colour. From this solution sulphuric acid precipitates the alizarin as an orange-yellow substance. It is allowed to settle in large tanks, and then is run, in the form of a yellowish mud, which contains either 10 or 15 per cent of dry alizarin, into barrels, and is in this form sent to the print-works, and used much in the same way as the original ground madder was used.

The alizarin mud, as I have called it, containing but 10 per cent of dry alizarin, is equal in dyeing-power to about 8 times its weight of the best madder, and is the pure substance required for the dyeing, in place of a complicated mixture containing certain constituents which have a positively injurious effect on the colours produced.

The scientific knowledge and energy which Mr. Perkin has brought to bear on the manufacture of this colouring matter seem already to have worked wonders. The demand and supply of artificial alizarin are increasing at a most rapid rate, and yet the manufacture of it seems hardly to have commenced. The value of madder has much decreased; and in fact, judging by what occurred in the year of revolution and commercial depression (1848), when the price of madder fell for a time to a point at which it was considered it would no longer remunerate the growers to produce it, that point has now been again reached, but certainly from very different reasons. Last year* artificial alizarin equal in value to about one-fourth of the madder imported into England was manufactured in this country. This year the amount will be much larger.

Thus is growing up a great industry, which, far and wide, must exercise most important effects. Old and cumbrous processes must give way to better, cheaper, newer ones; and, lastly, thousands of acres of land in many different parts of the world will be relieved from the necessity of growing madder, and be ready to receive some new crop. In this sense may the theoretical chemist be said even to have increased the boundaries of the globe.

ON THE ENERGIES OF THE IMPONDERABLES, WITH ESPECIAL REFERENCE TO THE MEASUREMENT AND UTILISATION OF THEM.†

By the Rev. ARTHUR RIGG, M.A.

(Continued from page 141.)

LECTURE IV.

The Energy of Affinity, especially with reference to Considerations for the Measurement and Utilisation of it.

This energy of affinity assumes many Protean forms, embracing facts in very opposite phases. At one time it seems to hold elemental matter in adamantine chains so firmly that no appliances, such as heat or light or electricity, can undo the bonds; at another time there seems to be a repellent power of affinity (contradictory though the expression may sound) so influencing, that though every facility for voluntary combination be presented, yet none of these inducements accomplish this combination. For example, the oxygen and nitrogen in the atmosphere, which for all general purposes may be said never to enter combination whilst acting as atmosphere. Again, oil and water—neither shaking nor heating can cause mixture, let alone combination. This repellent power is utilised in vitality thus:—The fluid which lubricates the eyeball would continually pass over the edges of the lids, and so run down the cheeks, were there not glands upon the edge of the lids that secrete a very little oil, and so by

* On the 1st of this month (September) the value of madder-roots in France was 24 to 26 francs per 50 kilogrammes. The average price in 1848 was 27, but in June and July of this year it was 22 francs.

† The Cantor Lectures, delivered before the Society of Arts.

virtue of this "repellent affinity" the ordinary fluid is confined to its appointed channel. If this fluid be excessive, the oily boundary is overflowed, and tears trickle down the cheeks.

On reference to the diagram on the wall, it is stated that the energy of affinity is manifested in mechanical action, and it is probably the source of the mechanical power utilised by men for manufacturing purposes. We find affinity operating under all circumstances in which the character of a resulting compound is different from that of the elementary bodies which constitute the compound. Affinity may be said to be kinetic when converted, and potential when in molecular relation. In other words, all the molecules of one body are somehow or other related by affinity to the molecules of another body, either directly or indirectly, when states of change are occurring. Under these circumstances, until the new molecular relations are called forth, there is potential energy: as these are brought about we get kinetic energy.

The term "Affinity," as employed in this course of lectures, needs an explanation. As a term in science it is fairly derived from that sense in which it ought to be used in conversation or ordinary writing. The word, when properly applied, is in reference to those connections which a marriage may have established between the relatives of the wedded pair. Prior to that marriage there were no relationships; after it, relationships enter by *affinity*. The relatives of the husband are connected to him by consanguinity, so are the relatives of the wife to her, but after the marriage these two sets of relatives are connected each to the other by affinity. This distinction makes clear that affinities are regarded only as between different bodies. No affinity can exist between lead and lead, or between oxygen and oxygen. As in social life, the legal relationships resulting from affinity and consanguinity are very different, so in science life the atoms which constitute the elementary parts of a simple body, and the molecules which constitute the elementary parts of a compound body, are tied together in bonds of different kinds.

Between atom and atom, or molecule and molecule of a like nature, there are no affinities. True, these are held together, but it is by what is sometimes called the force of cohesion. If atom or molecule of one nature is, thus unchanged, held to an atom or molecule of another nature, then the bond is one of adhesion. If, for example, these two plates of smooth glass be slid one over the other and pressed together they cohere. If gum be dropped on one and the other pressed upon it, they then adhere. Water adheres to many substances of very different constitution.

To cohesion we are indebted for the strength of solids. The cohesive force operates, but in marvellously different degrees, in ice, water, and steam. To adhesion we are indebted for those unions effected by cements, &c. With the intensity of these two subsidiary agents in the work of affinity this lecture is not concerned, although they perform no unimportant parts.

Between affinity, if used as a term in physics, and if used as a term in chemistry, there is this distinction:—Students in physics might classify cohesion and adhesion as branches of affinity. Students in chemistry would not admit the term (affinity) unless the composing elements after the influence of affinity have undergone such a change as to obliterate all traces of the originals. Hence the phrase "chemical" affinity, thus, by the prefix "chemical," excluding the physicist's views.

An experimental illustration may make clear the use of the term "affinity" by the respective students in physics and chemistry.

Here are two solutions, the one of gum dissolved in water, the other of camphor dissolved in spirits of wine. These two are respectively mixed, nevertheless there is in neither case any chemical affinity. If we add pure spirits of wine to the mixture of gum and water, we should destroy what the physicist might call the affinity, but

which the chemist does not admit to be such. On the other hand, if we add water to the solution of camphor we destroy the mixture there; a separation takes place, and in one case the gum, and in the other the camphor, is precipitated. The term "affinity," applied to the unions thus separated, would not to a physicist seem improper; the chemist would not permit the use of this word. It is in the chemist's sense that the word is used in the phrase "energy of affinity." He distinguishes thus:—the term "combination" is applied by him to the results of affinity, and to that which has just been described as a phenomenon in physics the chemist applies the term "mixture."

These preliminary distinctions prepare us for an explanation of what we are to understand by those affinities whose energies are to be considered. Used in a chemical sense, affinity is that power which influences bodies dissimilar in composition, form, and character to combine. The consequence of this union is the formation of new compounds, which may or may not be dissimilar in colour, form, and every fashion, to any of the composing bodies, which may or may not be possessed of properties and characters that are not even traceable in the originals. These compound bodies, thus unlike their progenitors, also establish relationships of affinity, and we are soon surrounded with numerous compounds, so diverse that all traces of the originals are to ordinary apprehensions totally obliterated.

There is, however, amongst these bodies a kind of clanship or caste, similar to that amongst the people of India. Thus, simple or elementary bodies combine only with simple or elementary ones; compound bodies only with compound ones.

For example—Oxygen, which is a simple body, enters into the alliance of affinity with the metals, which are also simple bodies.

Here is some pure metal—lead—in a state of very minute subdivision. It is enclosed in an air-tight glass tube. This lump of lead is exactly the same material. The difference is, that in the finely subdivided metal in the glass tube combination with oxygen will take place the moment it is exposed to the air, so that the atoms of lead which are soon to be shaken out are brought into contact with the oxygen—atom with atom.

Thus, on breaking off the end of the glass tube and shaking out the contents, you see the black particles, as they fall, glow with heat, owing to their rapid combination with the oxygen of the atmosphere. Here is a case of affinity, consequent on a state of subdivision—a case of affinity proper. Mr. Wills, who most kindly this evening gives us the benefit of his chemical knowledge and experimental skill, will now show you how strong is the affinity of oxygen for the steel blade of a knife; when heated and placed in a stream of oxygen the ignited particles of steel in the blade rapidly burn away. The same thing happens if a stream of oxygen is directed on any of the simple metals when raised to a red heat. In a hollow on this tile are some iron nails; by directing a stream of ignited hydrogen in oxygen upon them, the affinity is so strong that they not only melt but boil, and the ebullition is so powerful that a brilliant shower of molten metal is scattered around. Similarly, a piece of zinc when exposed to oxygen is rapidly consumed.

But when we deal with acids which are compounds, they do not ally themselves by affinity with the simple metals, but only with the oxides of the metals, which, like themselves, are compound bodies.

The range of the energies of affinities is very great. For example, oxygen and the metals. Oxygen can with difficulty be induced to unite with gold and platinum—hence these metals do not tarnish in the air; with sodium and potassium the affinities are so strong that the union is rapid enough to generate both light and heat. Either to facilitate or prevent such union, and so promote or retard the energy of affinity, has led to the adoption of various compounds, under the name of fluxes.

It may be well to explain that to this energy of affinity we may be said to owe the variety which the earth possesses. Reduce its compounds into their elements, and a sample of each of all of which the world is made might be arranged on this table. There are now only 63 reputed elements: from the affinities amongst these 63, whether taken by twos, or threes, or fours, or more, everything is made. Indeed, $\frac{1}{100}$ ths of the earth is made of 13 elements; the mathematician's calculation is an easy one which could tell the number of articles that might be formed by combining these 13 by twos, then by threes, then by fours, and so on to 13. There would thus, out of these elements, be 8191 different compounds. This number is very naturally increased from the operation of what may be called the law of combination in multiple and sub-multiple proportions. Allowing another 8191 for these multiples and sub-multiples, there would be in the world composed of these 13 elements 16,382 articles. Such a calculation as this is exceedingly simple, and the mathematician would say must be correct. Affinity, however, enters with a "veto." It claims the right to determine the nature of any combination or set of combinations, and in the exercise of this claim the character and constitution of the combining elements are so completely altered as to have lost all obvious trace of their original, and, therefore, when the combination by threes takes place the result does not partake of the character of any one of the components. This change of character is what the mathematician's calculation does not reckon upon; indeed such a calculation is based upon the physicist's interpretation of the word affinity, and it ignores the chemist's views.

The problem which is now before us is to define a mode of measuring the transformations in every shape introduced by affinity amongst these thirteen elements; a problem very simple, as thus stated, but wondrously complicated,—in fact only capable of an approximate or inferential solution, which is, practically, no solution at all.

In a homely way this difficulty may be illustrated within the walls of many a house. Assume the residents to be a father and mother and thirteen children. Who can tell the combinations consequent upon what may be called the mutual affinities existing amongst these thirteen children? Even from day to day the stability of that family cannot be ensured. The combinations of twos and threes, which yesterday gave promise of permanency, is to-day dissolved, and these molecular children form other alliances. This microcosm of a world is under the influence of new feelings, changed tastes; indeed it passes, with more than electrical rapidity, from a summer-like happiness to a wintry gloom—from a peaceful calm to lurid flashes—sad forebodings of domestic storms!

Well, amongst the affinities of the thirteen terrestrial elements similar changes and relations are induced. Whilst we may be able to tell with unerring exactitude how any two may act, if left to settle themselves under the sole influence of their dual affinities, when three or four, or more, come together, certain perplexity results.

(To be continued).

much less prominent than in "Chemical Handicraft," whilst the amount of information on the use of the various pieces of apparatus and the principles they illustrate is much enlarged. We have no doubt that the work will be found very valuable both to teachers and students in enabling them to select without loss of time the precise articles they may require. In looking over the descriptions and figures of specific gravity bottles, pipettes, burettes, &c., we cannot help expressing a wish that the "septem" may at an early date disappear both from graduated apparatus in the laboratory and from the pages of scientific manuals. We ask further,—is it beyond the power of scientific men to agree upon some one standard graduation for hydrometers, both for liquids lighter and for those heavier than water? If the Continent has the advantage over England in the simplicity of its weights and measures, it falls behind us in another respect, owing to the number and complexity of its hydrometric scales.

We presume that the volume before us is the first of a series which will doubtless embrace all the other departments of physical science.

Lectures on Practical Pharmacy. By BARNARD I. PROCTOR.
London: J. and A. Churchill.

THE increasing demand for scientific instruction, about which we hear so much, is not always of that tangible nature which leads to permanent results. Those who come forward to meet it often find it vanish away. Of this our author gives a somewhat pathetic instance in his "prefatory letter." About a dozen years ago, in consequence of a local movement, he accepted a lectureship on pharmacy at the Newcastle Pharmaceutical School. "The attendance, at first satisfactory, gradually diminished till, during the third year of the school's existence, I had the honour of reading a paper on Sulphur, and performing the experiments in illustration, before an audience of one." Who that has ever accepted the honorary chair in any branch of physical science at a Mechanics' Institute, or any similar body, has not to tell of some analogous experience? Such results wound our vanity, indeed; but they do something more. They convince us that a long time must elapse, or a radical change ensue, before we can hope to overtake our competitors on the other side of the North Sea.

From this abortive pharmaceutical school, and from the pharmacy lectureship subsequently appended to the Newcastle Medical College and held by the author, has sprung the present work. Mr. Barnard modestly proclaims himself as still a student rather than a teacher, and apologises for the want of uniformity in thermometrical scales, weights, and measures, equivalent numbers and nomenclatures made use of. Nomenclatures have, indeed, become so numerous and complicated, that a dictionary of chemical synonyms would be of no trifling utility to all who have to make themselves acquainted with chemical literature.

The work before us contains sections on the principal chemical operations practised in pharmacy; on the various classes of official preparations; on dispensing and reading prescriptions, illustrated with lithographed fac-similes of medical kakography; on qualitative and quantitative testing, and on the pharmacy of special drugs. Each section concludes with a brief summary or recapitulation, and questions for self-examination. The various processes are carefully and clearly described, with indication of niceties important to success, but which the student might otherwise overlook. We might instance the lectures on precipitation, crystallisation, diffusion, and dialysis, as happy specimens of the golden mean between the diffuseness that encumbers and the brevity that perplexes. The author contrives, in passing, to point out not a few prevalent errors both in standard works and in vague professional opinion, whilst the only flaw which we have detected is the statement,—probably a typographical error,—that the *sulphate* of antimony treated with strong

NOTICES OF BOOKS.

Scientific Handicraft; a Descriptive, Illustrated, and Priced Catalogue of Apparatus, suitable for the Performance of Elementary Experiments in Physics. By J. J. GRIFFIN, F.C.S. Vol. I.; Mechanics, Hydrostatics, Hydrodynamics, and Pneumatics. London: J. J. Griffin and Sons.

MOST of our readers are familiar with Griffin's "Chemical Handicraft," a work which is at once a trade catalogue and, to some extent, a treatise on chemical manipulation. The book before us is an extension of the same idea to other departments of experimental science. It must, however, be noted that the mere trade department is

hydrochloric acid evolves sulphuretted hydrogen. The illustrations are numerous and appropriate, but a more complete index would have been beneficial. Altogether we must pronounce the work a good specimen of a treatise on chemistry as applied to a special art, and as such we can recommend it to pharmaceutical students and to pharmacists in general.

CORRESPONDENCE.

PREPARATION OF NORMAL ACID.

To the Editor of the Chemical News.

SIR,—I find the following a very easy and accurate method of making a standard acid, and as I have not seen it in any of the books on analysis, perhaps it may be of some use:—

Dilute commercial HCl with ten times its volume of water, pass an excess of SH_2 through the mixture and boil for a few minutes, allow to settle, then filter or decant off the precipitate. It is next to be distilled until 9-roths of the acid has passed over, and the distillate diluted to about 1020 sp. gr.

A piece of Iceland spar (about 8 or 10 grms.) is to be accurately weighed and placed in a flask together with 100 c.c. of the acid as prepared above. A chloride of calcium tube, filled with pieces of glass, is to be fitted to the flask, as in figure. A few drops of solution of litmus (which must be just blue) is to be poured through the CaCl_2 tube into the flask. The contents of the flask must be kept boiling gently until the litmus in it turns blue, then the remains of the crystal is to be taken out, washed, dried, and re-weighed. The loss in weight of the crystal indicating the strength of the acid, the latter can now be standardised. Thus, as 5 is to the loss of weight in grammes of the crystal, so is 100 c.c. to the number of c.c. of the acid, which must be taken and made up to 100 c.c. As the litmus in the CaCl_2 tube remains blue, we know that there has been



no loss of acid.—I am, &c.,

GEORGE DUERR.

The Laboratory, Heywood,
September 9, 1873.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopaedic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgement. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, August 18, 1873. (Continued).

Secondary Currents and their Applications.—Extract from memoir by M. Planté.—In studying the phenomena of his secondary couples (formed with plates of lead) the author found that the chemical change in the electrodes, which forms the source of the secondary current, is rendered more complete by a primary current being passed alternately in opposite directions, and repose allowed between each double action. By the former, the deposits of oxide are reduced, then recombined, and the electrodes are thus modified in molecular constitution, not

only at the surface, but by degrees interiorly, giving an increasing effect for years. By the latter (repose) the deposits of oxidised or reduced metal acquire a crystalline texture and a strong adherence, which contributes to protect the subjacent deposits tending to form under the action of the primary current. These operations M. Planté designates the *formation of secondary couples*. A secondary couple with less than half a metre of surface properly formed will, when charged with two Bunsen elements, render a platinum wire half a m.m. diameter during twenty minutes, or a wire $\frac{1}{8}$ m.m. diameter for an hour, without any communication with the primary source, and even forty-eight hours after being charged. After formation has once been effected the secondary couple may be charged by a current acting always in the same direction. M. Planté exhibited an apparatus so arranged that, by touching a metallic point in a box containing a secondary couple, a platinum wire was heated, and might be used to light a candle, a spirit-lamp, or gas. The primary pile consisted of 3 elements of zinc and water, copper and sulphate of copper. The secondary couple once charged may give a hundred consecutive lightings. With an apparatus somewhat larger one may obtain 3000 to 4000. This mode obviates many disadvantages connected with the use of matches; and it is very economical. For there is no expense connected with the secondary couple; the lead and liquid do not need renewal. And to maintain the weak current of the primary pile necessary to charge the secondary couple one has only to add some crystals of sulphate of copper; the consumption of which is very small compared with the large number of lightings obtainable. M. Planté proposes also to employ his secondary couples for electric bells, and describes how this may be done.

Variations of Urea under the Influence of Caffein, Coffee, and Tea.—M. Rabuteau.—The author cites his experiments made in 1870 in opposition to those recently made by M. Roux, who considers tea and coffee do not prevent denutrition of tissues.

Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften, Vienna, October, 1872.

On Nicotin.—Dr. H. Weidel.—The author chiefly examined combinations of nicotinic acid, which was obtained by oxidation of nicotin with nitric acid, and to which he gives the formula $\text{C}_{10}\text{H}_8\text{N}_2\text{O}_4$. The compounds studied were those with nitric acid, hydrochloric acid, bromide of hydrogen, sulphuric acid, hydrochlorate of double salt of platinum, two with silver, and lime. The platinum salt and the lime combinations gave beautiful crystals of the oblique prismatic system. Dr. Weidel further compared with nicotinic acid another acid obtained from nicotin by Huber, by oxidation with chromic acid, viz. $\text{C}_6\text{H}_5\text{NO}_2$.

On Excretin.—F. Hinterberger.—Marcel regarded excretin as a sulphur-containing substance, with formula $\text{C}_{28}\text{H}_{156}\text{SO}_2$. Hinterberger has succeeded in getting it free from sulphur, and gives as its simplest formula $\text{C}_{28}\text{H}_{156}\text{O}$; which shows a close correspondence to cholesterol, $\text{C}_{26}\text{H}_{44}\text{O}$. But cholesterol is less easily dissolved in vinegar than excretin, and the solution shows in the microscope beautiful sericeous six-sided prisms, while the excretin solution forms round masses. Treated with bromine excretin gave a crystalline compound with formula $\text{C}_{20}\text{H}_{12}\text{Br}_2\text{O}$; but the author did not succeed in preparing chloride of excretin.

Behaviour of Non-Conducting Substances under the Influence of Electrical Forces.—M. L. Boltzmann.—The author deduced from Helmholtz's theory of dielectricity that electric forces may exercise considerable attraction on a non-conductor simply through dielectric polarisation; that a non-conducting ball in a homogeneous electric field should be $\frac{D-1}{D+2}$ times as strongly attracted as a similar and insulated conducting ball acted on by the

same force through induction; D being the constant of dielectricity. In a first series of experiments values of D were obtained with a condenser, a battery, and an electrometer for hard gum, sulphur, paraffin, and colophony. In a second series the method of experiment was briefly as follows:—A ball of the insulating substances was hung by a silk thread at the arm of a delicate balance whose motions were indicated by a small mirror. Near this movable ball was a fixed one which could be charged from a machine with either positive or negative electricity. For the non-conducting ball an equal sized conducting one could be substituted. A second balance with conducting ball suspended near the fixed ball served as measure of the quantity of electricity. Comparison was now made between the attractions of the non-conducting and the conducting balls on the first balance to the fixed ball. The numbers given in a table show how much more the conducting ball was attracted than the non-conducting one. According to the theory of dielectrics these numbers should have the value $\frac{D+1}{D-2}$. The values of D deduced

from this are compared with those from the former measurement. In some cases there is pretty close agreement; in others difference. It was observed that the longer the electric action the more considerable was the dielectric polarisation. M. Boltzmann thinks his method should yield valuable results on the hitherto little studied behaviour of insulators in the electric field. The author further views his numbers in connection with Maxwell's hypothesis that light and electricity are different forms of motion in one and the same medium. Between the dielectric constant, D, and the refractive index, n , of any substance, Maxwell obtained the relation $n = \sqrt{\epsilon \mu}$, where μ is the coefficient of magnetic induction. This coefficient in the four above mentioned substances cannot be very different from air, which is taken as = 1. So that we have the index of refraction equal to the square root of the constant of dielectricity. M. Boltzmann accordingly compares the square roots of these constants as found by his method with the refractive indices as determined by Wollaston's method; and the differences are not sufficiently great not to be attributed to unavoidable errors of observation. He considers these results, though not so accurate as to lead to the identification of light and electricity, yet furnish strong support to Maxwell's theory.

Stroboscopic Determination of the Pitch of Tones.—M. Mach.—In the apparatus used by the author there is a cylinder which makes three revolutions in a second, and is divided into five octaves. At one end of it begins 10 bands, which, however, become more numerous and dense towards the other end, being there 320. To the axis of a syren is fixed a disc having equidistant radial slits of the same number as the holes in the syren-disc. The surface of the rotating cylinder is looked at through this slitted disc, while the syren tone is gradually raised. According to the stroboscopic principle the bands look distinct and at rest where there pass before the eye an equal number of them and of slits in the disc. If a scale of numbers of vibration be attached to the cylinder, the number of vibrations of the syren can be at once ascertained by observing the part corresponding to the distinct and still ring of the cylinder. One sees, however, distinct and at rest, not only the part of the cylinder corresponding to the number of vibrations of the syren, but also all those parts which correspond to the harmonic over tones. Of all such parts it is, of course, that one which furnishes the smallest number of vibrations that corresponds to the vibration-number of the syren. (The author gives further details of the apparatus.) The determination may be varied in accuracy by varying the bands on the paper of the rotating cylinder. The apparatus may be applied to other sounding bodies. Thus let a mono-chord string be stretched at right angles to the axis of the cylinder; then simple teeth (Zachen) appear where the sounding string is opposite that part of the cylinder indicating the same

number of vibrations. Another application is to attach small mirrors to tuning-forks, and watch in them the image of the rotating cylinder. An organ pipe may be also submitted to observation with aid of König's capsules and dancing jets.

Heat Equilibrium among Gas Molecules.—Boltzmann.—A lengthy mathematico-physical paper, treating the subject under the six heads of—(1) Consideration of one-atomed gas molecules; (2) replacement of integrals with sums; (3) diffusion, friction, and conduction of heat in gases; (4) consideration of several-atomed molecules; (5) the molecules do not make many vibrations between one collision and the next; (6) solution of equation and calculation of eutrophy.

Moniteur Scientifique, du Dr. Quesneville,
September 1873.

Theory of Tanning.—A. Reimer.—A continuation of the important treatise translated from *Dingler's Polytechnisches Journal*, 1872.

On Anthrapurpurin.—W. H. Perkin.—A translation from the *Transactions* of the London Chemical Society.

On Anilin Black.—Ch. Lauth.—Abstracts of this paper and of the two following have already appeared in the *CHEMICAL NEWS*.

Wool Dyeing with Anilin Green.—Ch. Lauth.
Action of Hydrochloric Acid Gas on the Compound Ammonias.—Ch. Lauth.

Process for Determining the Anilin Colours by Means of the Hydrosulphite of Soda.—A. Stamm.—This process has been already given in the *CHEMICAL NEWS*.

Chemical Guide to the Vienna Exhibition.—A. Bauer and J. Singl.—A translation from the *Transactions* of the Berlin Chemical Society.

Determination of Paraffin in Candles sold as Stearin.—E. Donath.—M. Hock had proposed to saponify the sample to be examined with a soda lye, and to salt out the soap formed by an addition of common salt. This precipitate carries down with it the paraffin, which of course has not been saponified by the alkali. The whole is collected on a filter, washed with water, or with very dilute alcohol, which dissolves out the soap, and dried at 35° to 40°. The paraffin is then dissolved in ether, and the solution evaporated to dryness. The weight of the residue shows the amount of paraffin. Donath having tried this method finds that it is very difficult to remove the soap from the filter in the cold by washing with water or dilute alcohol, whilst if the solvent be applied hot, or even slightly warmed, the paraffin forms an emulsion and runs through the filter. The solution of paraffin in ether is also a slow process. Hence Donath proposes the following modification:—6 grms. of the sample are boiled for half-an-hour with 200 to 300 c.c. of potash-lye, specific gravity, 1.15, and chloride of calcium is then added so as to produce a complete precipitation. If a large admixture of paraffin is suspected a quantity of carbonate of soda is added to the chloride of calcium, which gives rise to the formation of carbonate of lime, and renders the precipitate more easy to pulverise. The lime-soap with which the paraffin is mechanically entangled is washed on the filter with hot water and dried at 100°. The mass is then pulverised and exhausted in a displacement apparatus with cerosolin (essence of petroleum). The solution obtained is evaporated, and the residue after being dried at 100° is weighed as paraffin. On operating upon known mixtures the author has obtained results correct to 0.3 per cent.

Determinations of Acids in Oils.—M. Burstynn.—To 100 c.c. of the oil in question the author adds an equal volume of alcohol at 90 per cent and shakes strongly. The whole is then left to settle for some hours, when two layers are formed. The one is oil perfectly free from acid,

the other consists of alcohol containing the fatty acids and a trace of oil. Of this latter portion 20 c.c. are taken and titrated with a standard solution of soda. If several free fatty acids are present, the calculation is made for one only, employing the equivalent of the one present in the largest proportion. The results obtained are sufficiently accurate for practical purposes.

Adulteration of Wax with Tallow.—M. Hardy.—Wax floats upon alcohol at 29°. By determining the strength which alcohol must have so that the sample may float upon its surface, the quantity of wax may be found in a sample falsified with tallow only:—

When the Alcoholometer marks—	The Wax contains—
29°00'	100 per cent
29°03'	75 "
29°05'	50 "
29°07'	25 "
29°10'	0 "

Determination of Manganese in Cast-Irons and Steels.—F. Kiesser.—One of the main causes of the loss of manganese in these determinations springs from the employment of too large an amount of acetate of soda in the previous precipitation of the iron. The author finds that in a perfectly neutral solution 1 gm. acetate of soda suffices to precipitate completely 1.1 gm. of iron in 500 c.c. of solution, and even in presence of 1 gm. of acetic acid. When the determination of the manganese alone is required, he cools the liquid, makes up its volume to 500 c.c., filters through a dry filter, and determines the manganese in 250 c.c.

Definition of Explosive Force.—M. R. Radau.—A mathematical paper on the measurement of the force of explosive bodies.

Means of Comparing Samples of Gunpowder.—M. de Tromenc.—The apparatus proposed is a cylindrical vessel of cast steel of the capacity of half a litre. The sides are 3 to 4 centimetres in thickness. The cylinder is closed with a screw stopper pierced by a central channel provided with a tap and two lateral orifices, into which are cemented two wires from an electric apparatus to ignite the charge. It would be useful to fix a thermo-electric element in one of the sides of the cylinder to indicate the temperature of the gases in periods following the explosion. The cylinder is placed in a sheet-iron receiver full of water which serves as a calorimeter, and which is again enclosed in a trough full of cotton to avoid loss of heat. The cylinder is fixed immovably by a pressure-screw resting upon the stopper. A thermometer measures the temperature to about 1/10th of a degree. The water is provided with an agitator.

Heat of the Combustion of Explosive Bodies.—M. M. Roux and Sarrau.—A mathematical paper.

Pyrometry for the Determination of High Temperatures.—J. Salleron.—The description of this instrument would be unintelligible without the accompanying diagrams.

Revue Universelle des Mines, de la Metallurgie, des Travaux Publiques, des Sciences et des Arts Appliqués à l'Industrie, May and June, 1873.

Chemical Industry at the Vienna Exhibition.—This paper is a translation from the German Catalogue of the Exhibition, and is mainly due to Prof. A. W. Hofmann, of Berlin. The subjects principally treated are of the recent improvements in the manufactures of sulphuric acid, of soda, of chlorine, of potash, of paraffin, and of colouring matters. We extract the following interesting facts concerning the Stassfurt and Leopoldsdorf potash works:—The chloride of potassium obtained, ranging in strength from 98 to 80 per cent, serves for the preparation of saltpetre, sulphate of potash, potash, and alum. The annual yield is about a million centners. The potassic

manurial salts are mixtures of the chloride of potassium, with different proportions of sulphate of magnesia and common salt. The annual yield is a million and a quarter centners. The production of potash and sulphate of potash amounts to fifty thousand. Sulphate of magnesia, crude and crystallised (Kieserite and Epsom salts), is obtained to the extent of a quarter of a million centners. Chloride of magnesium, crystallised and fused, 130,000 centners. Sulphate of soda, crystallised and calcined, is obtained from sulphate of magnesia and chloride of sodium by double decomposition at low temperatures, to the extent of 150,000 centners. About 400 centners of boric acid, and 700 of bromine are also produced yearly. Since the opening of the Stassfurt mines the price of chloride of potassium has fallen from 218 to 248 per centner to from 78 to 98. Bromine up to 1865 cost 48s. to 51s. per kilo; its price is now from 9s. to 10s. 6d. The deposits of Kalnex, in Galicia, have only been worked since 1869. There are found there rich and heavy beds of sylvin and kainite; below which carnallite will probably be discovered. The section on colouring matters will give the reader cause for reflection. That England should be obliged to import 8000 cwts. of artificial alizarin yearly whilst she exports the raw material, anthracene, is simply a national disgrace. That Germany alone produces about one-half of the anilin colours consumed in the world is a fact that clashes strangely with our notions of manufacturing supremacy.

Condition of Mining in the Island of Sardinia.—M. Sella.—(Continuation.)—Ores of iron, copper, manganese, and antimony, and the lignites of the tertiary basin of Gonnesa have been worked at different times, but without success. Iron ores are tolerably abundant, especially the magnetic protoxide, which is found in veins and masses in the granite and the superjacent Silurian schists. Hematite is found in the trachytic formation. The principal copper ore is chalcopryrite, found in the argillaceous schists of the Silurian regions. Some fine specimens of sulphide of antimony have been found at Su Serrigiu, in the centre of the island, accompanied by an argillaceous gangue. Pyrolusite is found to a considerable extent at Capo Rosso, on the western coast, but of low quality. At Fluminimaggiore occurs an ore of nickel and cobalt, yielding 20 per cent of the two metals. The difficulty of transport, and the distance from a market, render many of the Sardinian mineral deposits practically worthless.

MISCELLANEOUS.

The American Association for the Advancement of Science.—This Association held its twenty-second annual meeting at Portland, Maine, beginning Wednesday, August 20th. The Officers of the meeting are as follows:—President, Prof. Joseph Lovering, of Cambridge, Mass.; Vice-President, A. H. Worthen; Permanent Secretary, F. W. Putnam; General Secretary, C. A. White. The attendance of members was large, and a goodly number of papers were presented. Strictly chemical papers, however, were few, the deficiency being even more marked than usual. The titles of the papers on chemical and closely related subjects are as follows:—"On the Silt Analysis of Soils and Clays," E. W. Hilgard; "Analysis of Mississippi Soils and Subsoils," E. W. Hilgard; "On the Distribution of Soil Ingredients in the Sediments obtained by Silt Analysis," R. H. Loughbridge; "On the Influence of Strength of Acid, and Time of Action on the Results of Chemical Soil Analysis," R. H. Loughbridge; "Remarks on Plate Lime-Glass and the Manufacture of Glass in General," L. Feuchtwanger; "The Chemistry of Copper Matte," T. Sterry Hunt; "Metaphysical Theory of Chemistry versus the Atomic," Clinton Roosevelt. As in former years subjects connected with geology and natural history formed the bulk of the papers.

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BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

BRADFORD MEETING, SEPTEMBER 17, 1873.

INAUGURAL ADDRESS OF THE PRESIDENT, ALEXANDER W. WILLIAMSON, PH.D., F.R.S., F.C.S.

(Concluded from p. 148).

I TRUST that the facts which I have submitted to your consideration may suffice to show you how fallacious is that materialistic idea of Physical Science which represents it as leading away from the study of man's noblest faculties, and from a sympathy with his most elevated aspirations, towards mere inanimate matter. The material work of science is directed by ideas towards the attainment of further ideas. Each step in science is an addition to our ideas, or an improvement of them. A science is but a body of ideas respecting the order of nature.

Each idea which forms part of Physical Science has been derived from observation of nature, and has been tested again and again in the most various ways by reference to nature; but this very soundness of our materials enables us to raise upon the rock of truth a loftier structure of ideas than could be erected on any other foundation by the aid of uncertain materials.

The study of science is the study of man's most accurate and perfect intellectual labours; and he who would know the powers of the human mind must go to science for his materials.

Like other powers of the mind, the imagination is powerfully exercised, and at the same time disciplined, by scientific work. Every investigator has frequent occasion to call forth in his mind a distinct image of something in nature which could produce the appearances which he witnesses, or to frame a proposition embodying some observed relation; and in each case the image or the proposition is required to be true to the materials from which it is formed. There is, perhaps, no more perfect elementary illustration of the accurate and useful employment of the imagination than the process of forming in the language of symbols, from concrete data, one of those admirable general propositions called equations; on the other hand, the contemplation of the order and harmony of nature as disclosed to us by science supplies the imagination with materials of surpassing grandeur and brilliancy, while at the same time affording the widest scope for its efforts.

The foregoing considerations respecting the meaning and use of scientific work will, I trust, afford us aid in considering what measures ought to be taken in order to promote its advancement, and what we can do to further the adoption of such measures.

Like any other natural phenomenon, the growth of knowledge in the human mind is favoured and promoted by certain circumstances, impeded or arrested by others; and it is for us to ascertain from experience what those circumstances respectively are, and how the favourable ones can be best combined to the exclusion of the others.

The best and noblest things in this world are the result of gradual growth, by the free action of natural forces; and the proper function of legislation is to systematise the conditions most favourable to the free action which is desired.

I shall consider the words "Advancement of Science" as referring to the development and extension of our systematic knowledge of natural phenomena by investigation and research.

The first thing wanted for the work of advancing science is a supply of well-qualified workers. The second thing is to place and keep them under the conditions most favourable to their efficient activity. The most suitable men must be found while still young, and trained to the work. Now I know only one really effectual way of finding the youths who are best endowed by nature for the purpose; and that is to systematise and develop the natural conditions which accidentally concur in particular cases, and enable youths to rise from the crowd.

The first of these is that a young man gets a desire for knowledge by seeing the value and beauty of some which he has acquired. When he has got this desire, he exerts himself to increase his store; and every difficulty surmounted increases his love of the pursuit, and strengthens his determination to go on. His exertions are seen by some more experienced man, who helps him to place himself under circumstances favourable to further progress. He then has opportunities of seeing original inquiries conducted, perhaps even of aiding in them; and he longs to prove that he also can work out new truths, and make some permanent addition to human knowledge. If his circumstances enable him to prosecute such work, and he succeeds in making some new observations worthy of publication, he is at once known by them to the community of scientific men, and employed among them.

We want, then, a system which shall give to the young favourable opportunities of acquiring a clear and, as far as it goes, a thorough knowledge of some few truths of nature such as they can understand and enjoy—which shall afford opportunity of further and further instruction to those who have best profited by that which has been given to them, and are anxious to obtain more—which shall enable the best students to see what original investigation is, and, if possible, to assist in carrying out some research—and, finally, which shall supply to each student who has the power and the will to conduct researches, all material conditions which are requisite for the purpose.

But investigators, once found, ought to be placed in the circumstances most favourable to their efficient activity.

The first and most fundamental condition for this is, that their desire for the acquisition of knowledge be kept alive and fostered. They must not merely retain the hold which they have acquired on the general body of their science; they ought to strengthen and extend that hold, by acquiring a more complete and accurate knowledge of its doctrines and methods; in a word, they ought to be more thorough students than during their state of preliminary training.

They must be able to live by their work, without diverting any of their energies to other pursuits; and they must feel security against want, in the event of illness or in their old age.

They must be supplied with intelligent and trained assistants to aid in the conduct of their researches, and whatever buildings, apparatus, and materials may be required for conducting those researches effectively.

The desired system must therefore provide arrangements favourable to the maintenance and development of the true student spirit in investigators, while providing them with permanent means of subsistence, sufficient to enable them to feel secure and tranquil in working at science alone, yet not sufficient to neutralise their motives for exertion; and at the same time it must give them all external aids, in proportion to their wants and powers of making good use of them.

Now I propose to describe the outlines of such a system, framed for the sole purpose of promoting research, and then to consider what other results would follow from its working.

If it should appear possible to establish a system for the

efficient advancement of science, which would be productive of direct good to the community in other important ways, I think you will agree with me that we ought to do all that we can to promote its adoption.

Let the most intelligent and studious children from every primary school be sent, free of expense, to the most accessible secondary school for one year; let the best of these be selected and allowed to continue for a second year, and so on, until the *élite* of them have learnt all that is to be there learnt to advantage. Let the best pupils from the secondary schools be sent to a college of their own selection, and there subjected to a similar process of annual weeding; and, finally, let those who get satisfactorily to the end of a college curriculum be supplied with an allowance sufficient for their maintenance for a year, on condition of their devoting their undivided energies to research, under the inspection of competent college authorities, while allowed such aids and facilities as the college can supply, with the addition of money-grants for special purposes. Let all who do well during this first year be allowed similar advantages for a second, and even a third year.

Each young investigator thus trained must exert himself to obtain some appointment, which may enable him to do the most useful and creditable work of which he is capable, while combining the conditions most favourable to his own improvement.

Let there be in every college as many Professorships and Assistantships in each branch of science as are needed for the efficient conduct of the work there going on, and let every Professor and Assistant have such salary and such funds for apparatus, &c., as may enable him to devote all his powers to the duties of his post, under conditions favourable to the success of those duties; but let each Professor receive also a proportion of the fees paid by his pupils, so that it may be his direct interest to do his work with the utmost attainable efficiency, and attract more pupils.

Let every college and school be governed by an independent body of men, striving to increase its usefulness and reputation, by sympathy with the labours of the working staff, by material aid to them when needed, and by getting the very best man they can, from their own or any other college, to supply each vacancy as it arises.

In addition to colleges, which are and always have been the chief institutions for the advancement of learning, establishments for the observation of special phenomena are frequently needed, and will doubtless be found desirable in aid of a general system for the advancement of science.

Now, if a system fulfilling the conditions which I have thus briefly sketched out were once properly established on a sufficient scale, it ought to develop and improve itself by the very process of its working; and it behoves us, in judging of the system, to consider how such development and improvement would come about.

The thing most needed at the present time for the advancement of science is a supply of teachers devoted to that object—men so earnestly striving for more knowledge and better knowledge as to be model students, stimulating and encouraging those around them by their example as much as by their teaching. Young men do not prepare themselves in any numbers for such a career:—

(1). Because the chief influences which surround them at school and at college are not calculated to awaken in them a desire to obtain excellence of such kind.

(2). Because they could not expect by means of such qualities to reach a position which would afford a competent subsistence.

Let these conditions be reversed, to the extent that existing teachers have powerful inducements to make their students love the study of science for its own sake, with just confidence that they will be able to earn a livelihood if they succeed in qualifying themselves to advance science, and the whole thing is changed. The first batch of young investigators will be dispersed among schools and colleges

according to their powers and acquirements, and will at once improve their influence upon the pupils, and enable them to send up a second batch better trained than the first. This improvement will go on increasing, if the natural forces which promote it are allowed free play; and the youth of each successive generation will have better and more frequent opportunities of awakening to a love of learning, better help and guidance in their efforts to acquire and use the glorious inheritance of knowledge which had been left them, better and more numerous living examples of men devoting their whole lives to the extension of the domain of truth, and seeking their highest reward in the consciousness that their exertions have benefited their fellow men, and are appreciated by them.

A young man who is duly qualified for the work of teaching the investigation of some particular branch of science, and who wishes to devote himself to it, will become a member of an association of men selected for their known devotion to learning, and for their ability to teach the methods of investigation in their respective subjects. Around this central group is arranged a frequently changing body of youths, who trust to them for encouragement and guidance in their respective studies.

Our young investigator finds it necessary to study again more carefully many parts of his subject, and to examine accurately the evidence of various conclusions which he had formerly adopted, in order that he may be able to lead the minds of his pupils by easy and natural, yet secure, steps to the discovery of the general truths which are within their reach. He goes over his branch of science again and again from the foundation upwards, striving each time to present its essential particulars more clearly and more forcibly, arranging them in the order best calculated to stimulate an inquiring mind to reflect upon their meaning, and to direct its efforts effectively to the discovery of the general ideas which are to be derived from them. He is encouraged in these efforts by the sympathy of his colleagues, and often aided by suggestions derived from their experience in teaching other branches of science, or by information respecting doctrines or methods which throw a light upon those of his own subject.

No known conditions are so well calculated to give a young investigator the closest and strongest grasp of his subject of which he is capable as those in which he is placed while thus earnestly teaching it in a college; and inasmuch as a thorough mastery of known truths is needed by every one who would work to advantage at the discovery of new truths of that kind, it will, in most cases, be an object of ambition to the ablest young investigators to get an opportunity of going through the work of teaching in a college, in order to improve themselves to the utmost for the work of original research. There is, however, another advantage to them in having such work to do; for the best way to ascertain at any one time what additions may be made to a science, is to examine the facts which have been discovered last, and to consider how far they confirm and extend the established ideas of the science, how far they militate against those ideas. An investigating teacher is constantly weaving new facts into the body of his science, and forming anticipations of new truths by considering the relation of these new facts to the old ones.

When our investigator has thus got a thorough mastery of his science and new ideas for its extension, he ought to have the opportunity of turning his improved powers to account by devoting more of his time to original research; in fact he ought to teach research by example more than hitherto, and less by elementary exercises upon known facts. If he has discharged the duties of his first post with manifest efficiency, he will be promoted, either in his own or some other college, to a chair affording more leisure and facility for original research by his own hands and by those of his assistants and pupils. Some investigators may find it desirable to give up after a while all teaching

of previously published truths, and confine themselves to guiding the original researches of advanced pupils, while stimulating them by the example of their own discoveries. But most of them will probably prefer to do elementary teaching work from time to time, for the sake of the opportunity of going over the groundwork of their science, with a knowledge of the new facts and enlarged ideas recently established.

Now it must be observed that such a system as the above, once developed to its proper proportions, so as to send annually to secondary schools many thousands of poor children who would otherwise never enjoy such advantages, and so as to train to original investigation a corresponding proportion of them, would not only provide more young investigators than would be needed for systematic teaching functions, but would also give a partial training of the same kind to many whose abilities proved to be insufficient, or whose tastes were not congenial to such pursuit. Some would be tempted by an advantageous opening in an industrial pursuit or in the public service to break off their studies before completion, and others would find, after completing their training, a position of that kind more desirable or more attainable than a purely scientific appointment. Not only would much good of other kinds be accomplished by this circumstance, but we may say with confidence that the system could not work with full advantage for its own special purpose of promoting the advancement of science if it did not diffuse a knowledge of the truths and methods of science beyond the circle of teachers.

There is an urgent need of accurate scientific knowledge for the direction of manufacturing processes, and there could not be a greater mistake than to suppose that such knowledge need not go beyond the elementary truths of science. In every branch of manufacture improvements are made from time to time, by the introduction of new or modified processes which had been discovered by means of investigations as arduous as those conducted for purely scientific purposes, and involving as great powers and accomplishments on the part of those who conducted them.

Any manufacturer of the present day who does not make efficient arrangements for gradually perfecting and improving his processes ought to make at once enough money to retire; for so many are moving onwards in this and other countries, that he would soon be left behind.

It would be well worth while to establish such a system of scientific education for the sake of training men to the habits of mind which are required for the improvement of the manufacturing arts; and I have no doubt that the expense of working the system would be repaid a hundred times over by the increase of wealth of the community; but I only mention this as a secondary advantage of national education.

A system of the kind could not expand to due dimensions, nor could it, once fully established, maintain itself in full activity, without intelligent sympathy from the community; and accordingly its more active-minded members must be taught some good examples of the processes and results of scientific inquiry, before they can be expected to take much interest in the results achieved by inquirers, and to do their share of the work requisite for the success of the system. I need hardly remind you that there are plenty of other strong reasons why some such knowledge of the truths of nature, and of the means by which they are found out, should be diffused as widely as possible through the community.

You perceive that in such educational system each teacher must trust to his own exertions for success and advancement; and he will do so if he is sure that his results will be known and compared impartially with those attained by others. Each governing body must duly maintain the efficiency of their school or college, if its support depend in some degree on the evidences of that efficiency; and they will try to improve their school

if they know that every improvement will be seen and duly appreciated.

The key-stone of the whole structure is the action of the State in distributing funds carefully among schools and colleges proportionally to the evidence of their doing good work, which could not be continued without such aid.

I am inclined to think that the State ought, as far as possible, to confine its educational grants to the purpose of maintaining and continuing good work which is actually being done, and rarely, if ever, to initiate educational experiments: first, because it is desirable to encourage private exertions and donations for the establishment of schools and colleges upon new systems, or in new localities, by giving the public full assurance that if any new institution establishes its right to existence, by doing good work for a while, it will not be allowed to die off for want of support; and, secondly, because the judicial impartiality required in the administration of public funds, on the basis of results of work, is hardly compatible with an advocacy of any particular means of attaining such results.

On the other hand, experience has shown that special endowments, which tie up funds in perpetuity for a definite purpose, commonly fail to attain their object under the altered circumstances which spring up in later generations, and not unfrequently detract from the efficiency of the institutions to which they are attached, by being used for objects other than those which it is their proper function to promote.

When there is felt to be a real want of any new institution for the promotion of learning, men are usually willing enough to devote time and money to the purpose of establishing it and giving it a fair trial. It is desirable that they should leave the State to judge of their experiment by its results, and to maintain it or not, according to the evidence of its usefulness. No institution ought, for its own sake, to have such permanent endowments as might deprive its members of motives for exertion.

The State could not, however, discharge these judicial functions without accurate and trustworthy evidence of the educational work done at the various schools and of its success. For this purpose a record must be kept by or under the direction of every teacher of the weekly progress of each pupil, showing what he has done and how he has done it. Official inspectors would have to see to these records being kept upon a uniform scale, so that their results might be comparable. The habit of keeping such records conduces powerfully to the efficiency of teachers; and, for the sake of the due development of the teaching system, it ought to prevail generally. Having such full and accurate means of knowing what opportunities of improvement pupils have enjoyed, and what use they have made of those opportunities, Government ought to stimulate their exertions and test their progress by periodical examinations. It is of the utmost importance to allow any new and improved system of instruction to develop itself freely, by the exertions of those who are willing to undertake the labour and risk of trying it on a practical scale; and the pupils who acquire upon such new system a command of any branch of science, ought to have a fair opportunity of showing what they have achieved and how they have achieved it. An able and impartial examiner, knowing the new systems in use, will encourage each candidate to work out his results in the manner in which he has been taught to work out results of the kind.

Examinations thus impartially conducted with a view of testing the success of teachers in the work which they are endeavouring to do, have a far higher value, and consequent authority, than those which are conducted in ignorance or disregard of the process of training to which the candidates have been subjected; and we may safely say that the examination system will not attain its full usefulness until it is thus worked in intimate connection with a system of teaching.

In order to give every one employed in the educational system the utmost interest in maintaining and increasing

his efficiency, it is essential that a due measure of publicity be given to the chief results of their respective labours. Schools and colleges ought, to a considerable extent, to be supported by the fees paid by pupils for the instruction received; and every professor being in part dependent upon the fees of his pupils will have a direct interest in attracting more pupils to his classes or laboratories. The fame of important original investigations of his own or his pupils, published in the scientific journals, is one of the natural means by which a distinguished professor attracts disciples, and the success of his pupils in after life is another. His prospects of promotion will depend mainly on the opinion formed of his powers from such materials as these by the governing bodies of colleges and by the public; for if each college is dependent for success upon the efficiency of its teaching staff, its governing body must do their best to fill up every vacancy as it arises by the appointment of the ablest and most successful professor whom they can get; and any college which does not succeed in obtaining the services of able men will soon lose reputation, and fall off in numbers.

There are, however, further advantages to the working of the system to be derived from full publicity of all its more important proceedings. It will supply materials for the formation of a sound public opinion respecting the proceedings of the authorities in their various spheres of action. A claim for money might be made upon Government by the rulers of some college upon inadequate grounds; or a just and proper claim of the kind might be disregarded by Government. Neither of these things will be likely to happen very often if the applications, together with the evidence bearing on them, are open to public scrutiny and criticism; and when they do occasionally happen, there will be a natural remedy for them.

If I have succeeded in making clear to you the leading principles of the plan to be adopted for the advancement of science, including, as it necessarily must do, national education generally, you will, I think, agree with me that, from the very magnitude and variety of the interests involved in its action, such system must of necessity be under the supreme control of Government. Science will never take its proper place among the chief elements of national greatness and advancement until it is acknowledged as such by that embodiment of the national will which we call the Government. Nor can the various institutions for its advancement develop duly their usefulness until the chaos in which they are now plunged gives place to such order as it is the proper function of Government to establish and maintain.

But Government has already taken, and is continuing to take, action in various matters affecting elementary popular education and higher scientific education, and it would be difficult to arrest such action, even if it were thought desirable to do so. The only practical question to be considered is how the action of Government can be systematised so as to give free play to the natural forces which have to do the work.

By establishing official examinations for appointments and for degrees, Government exerts a powerful influence on the teaching in schools and colleges, without taking cognisance, except in some few cases, of the systems of teaching which prevail in them. Again, they give grants of public money from time to time in aid of colleges or universities, or for the establishment of a high school under their own auspices. Sometimes they endow a professorship. In taking each measure of the kind they are doubtless influenced by evidence that it is in itself a good thing, calculated to promote the advancement of learning. But a thing which is good in itself may produce evil effects in relation to others, or good effects incommensurate with its cost. Thus examinations afford most valuable aid to educational work when carried on in conjunction with earnest teachers; yet, when established in the absence of a good system of education, they are liable to give rise to a one-sided training contrived with a special view of getting young men through the examinations. If

no properly educated young men were found for a particular department of the public service, and an examination of all candidates for such appointments were to be established for the purpose of improving the system of training, candidates would consider their power of answering such questions as appeared likely to be set as the condition of their obtaining the appointments, and they would look out for men able and willing to train them to that particular work in as direct and effective a manner as possible. The demand for such instruction would soon be supplied. Some teachers would undertake to give instruction for the mere purpose of enabling candidates to get through the examination, and, by the continued habit of such work, would gradually come to look upon the examiners as malignant beings who keep youths out of office, and whose vigilance ought to be evaded by such means as experience might show to be most effective for the purpose. Once this kind of direct examination-teaching has taken root, and is known to produce the desired effect of getting young men through the examinations, its existence encourages the tendency on the part of the candidates to look merely to the examination as the end and aim of their study; and a class of teachers is developed whose exertions are essentially antagonistic to those of the examiners.

There are, no doubt, teachers with a sufficiently clear apprehension of their duty, and sufficient authority, to convince some of the candidates that the proper object of their study should be to increase their power of usefulness in the career for which they are preparing themselves, by thoroughly mastering up to a prescribed point certain branches of knowledge; and that, until they had honestly taken the means to do this, and believed they had done it effectually, they ought not to go up for examination, nor to wish to commence their career.

But it is desirable that all teachers be placed under such circumstances that it may become their interest as well as their duty to co-operate to the utmost of their powers in the object for which the examiners are working. For this purpose their records of the work done under their guidance by each pupil ought to be carefully inspected by the examiners before framing their questions, and ought to be accepted as affording the chief evidence of the respective merits of the pupils.

This is not the place for considering how the general funds for an effective system of national education can best be raised, nor how existing educational endowments can best be used in aid of those funds. It is well known that some colleges of Oxford and Cambridge are possessed of rich endowments, and that many distinguished members of those universities are desirous that the annual proceeds of those endowments should be distributed upon some system better calculated to promote the advancement of learning than that which generally prevails. Indeed we may confidently hope that, true to their glorious traditions, those colleges will be led, by the high-minded and enlightened counsels of their members, to rely upon improving usefulness in the advancement of learning as the only secure and worthy basis of their action in the use of their funds, so that they may take a leading part in such system of national education as may be moulded out of the present chaos.

But the foundations of a national system of education ought to be laid independently of the present arrangements at Oxford and Cambridge, for we may be sure that the more progress the system makes the more easy will become the necessary reforms in the older universities and colleges.

It is clearly undesirable that Government should longer delay obtaining such full and accurate knowledge of the existing national resources for educational purposes, and of the manner in which they are respectively utilised, as may enable them to judge of the comparative prospects of usefulness presented by the various modes of distributing educational grants. They ought to know what has been done and what is doing in the various public educational

establishments before they can judge which of them would be likely to make the best use of a grant of public money.

We have official authority for expecting such impartial administration of educational grants; and it cannot be doubted that before long due means will be taken to supply the preliminary conditions.

You are no doubt aware that a Royal Commission was appointed some time ago in consequence of representations made to Government by the British Association on this subject, and it is understood that their instructions are so framed as to direct their particular attention to the manner in which Government may best distribute educational grants. The Commission is moreover composed of most distinguished men, and we have every reason to anticipate from their labours a result worthy of the nation and of the momentous occasion.

In speaking of public educational establishments, I refer to those which by their constitution are devoted to the advancement of learning without pecuniary profit to their respective governing bodies. The annual expenditure requisite for keeping up a national system of popular education will necessarily be considerable from the first, and will become greater from year to year; but once Englishmen are fully alive to the paramount importance of the object, and see that its attainment is within their reach, we may be sure that its expense will be no impediment. England would not deserve to reap the glorious fruits of the harvest of knowledge if she grudged the necessary outlay for seed and tillage, were it even ten times greater than it will be. It is no use attempting to establish a national system on any other than a truly national basis. Private and corporate funds inevitably get diverted from popular use, after a few generations, to the use of the influential and rich. A national system must steadily keep in view the improvement of the poor, and distribute public funds each year in the manner best calculated to give the youths of the poorest classes full opportunities of improvement proportional to their capacities, so that they may qualify themselves for the utmost usefulness to their country of which they are capable. The best possible security for the proper administration of the system will be found in the full and speedy publicity of all the particulars of its working.

It has been frequently remarked that a great proportion of English investigators are men of independent means, who not only seek no advancement as a reward of their labours, but often sacrifice those opportunities of improving their worldly position which their abilities and influence open up to them, for the sake of quietly advancing human knowledge. Rich and powerful men have very great temptations to turn away from science, so that those who devote their time and money to its service prove to us how true and pure a love of science exists in this country, and how Englishmen will cultivate it when it is in their power to do so.

Now and then a youth from the poorer classes is enabled by fortunate accidents and the aid of a friendly hand to climb to a position of scientific activity, and to give us, as Faraday did, a sample of the intellectual powers which lie fallow in the great mass of the people.

Now, the practical conclusion to which I want to lead you is, that it rests with you, who represent the national desire for the advancement of science, to take the only measures which can now be taken towards the establishment of a system of education worthy of this country, and adapted to the requirements of science. In the present stage of the business the first thing to be done is to arouse public attention by all practicable means to the importance of the want, and to get people gradually to agree to some definite and practicable plan of action. You will, I think, find that the best way to promote such agreement is to make people consider the natural forces which have to be systematised by legislation, with a view of enabling them to work freely for the desired purpose. When the conditions essential to any national system come to be duly appreciated by those interested in the

cause of education, means will soon be found to carry out the necessary legislative enactments.

The highest offices in the State are on our present system filled by men who, whatever their political opinions and party ties, almost infallibly agree in their disinterested desire to signalise their respective terms of office by doing any good in their power. Convince them that a measure desired by the leaders of public opinion is in itself good and useful, and you are sure to carry it.

And, on the other hand, England is not wanting in men both able and willing to come forward as the champions of any great cause, and to devote their best powers to its service.

I may well say this at Bradford after the results achieved by your Member in the Elementary Education Act.

Objections will, of course, be raised to any system on the score of difficulty and expense, more especially to a complete and good system. Difficult of realisation it certainly must be, for it will need the devoted and indefatigable exertions of many an able and high-minded man for many a long year. Only show how such exertions can be made to produce great and abiding results, and they will not be wanting. And as for expense, you will surely agree with me that the more money is distributed in such frugal and effective manner, the better for the real greatness of our country.

What nobler privilege is attached to the possession of money than that of doing good to our fellow men? and who would grudge giving freely from his surplus, or even depriving himself of some comforts, for the sake of preparing the rising generation for a life of the utmost usefulness and consequent happiness?

I confidently trust that the time will come when the chief item in the annual budget of the Chancellor of the Exchequer will be the vote for National Education; and when in some later age our nation shall have passed away, when a more true civilisation has grown up and has formed new centres for its throbbing life, when there are but broken arches to tell of our bridges and crumbling ruins to mark the sites of our great cathedrals—then will the greatest and noblest of England's works stand more perfect and more beautiful than ever; then will some man survey the results of Old England's labours in the discovery of imperishable truths and laws of nature, and see that her energy and wealth were accompanied by some nobler attributes—that while Englishmen were strong and ambitious enough to grasp power, they were true enough to use it for its only worthy purpose, that of doing good to others.

I must not, however, trespass longer upon your time and your kind attention. My subject would carry me on, yet I must stop without having half done justice to it.

If I have succeeded in convincing you that a National system of Education is now necessary and possible, and in persuading you to do what you respectively can to prepare the way for it, I shall feel that the first step is made towards that great result.

SECTION B.—CHEMICAL SCIENCE.

FOR the benefit of those of our readers who were prevented from attending the 1873 meeting of the Association we print short abstracts of the papers read before the Chemical Section, with a condensed report of the discussions. Those papers which are of sufficient importance will be inserted in full as quickly as our space will permit.

"Report on the Chemical Constitution and Optical Properties of Essential Oils."—The report consisted of a *résumé* of the results obtained during the previous year's work, in continuation of the work described in previous reports. The products of the actions of nitric acid on hesperidin, and the terpen present in oil of nutmegs (hesperic acid and myristic acid, &c.), were described, the conclusion drawn being that oil of turpentine, oil of nutmegs, and hesperidin are the different isomerides: some

probable inferences were also made as to the connections between the nature of isomerism and the intrinsic chemical energy of the different isomerides severally. The action of bromine on the oil of nutmeg and on hesperidin is the same as that on turpentine—namely, combination, the resulting dibromide being split up by heat into hydrobromic acid and cymen. The two varieties of cymen thus obtained were carefully compared with cymen from other sources—namely, the action of zinc chloride on myristic acid; the action of heat on the product of the action of phosphorus pentachloride on myristic acid, and that of phosphorus pentachloride on camphor; also with the cymen isolated from oil of turpentine and from crude nutmeg terpen; the terpen present by sulphuric acid, and that from oil of cummin. All these gave the same results on oxidation (terephthalic acid and acetic acid free from other products), had the same boiling-point (close to 176°C in each case), and had the sp. gr. 0.860, the specific dispersion 0.0405, and the refraction equivalent 75° , and from this it is inferred that there is but one kind of cymen as yet known, and not two, as supposed by some chemists. The oil of citronella has also been partially examined; it consists essentially of a substance having the composition of $\text{C}_{10}\text{H}_{16}\text{O}$; by the action of dehydrating agents it splits up into water and a terpen $\text{C}_{10}\text{H}_{16}$; and when bromine is added to it the resulting product breaks up, on heating, into water, hydrobromic acid, and cymen, apparently identical with the other samples examined.

Dr. GLADSTONE: One very interesting point that rose in this investigation was the refraction equivalent of the isomeric bodies of the composition $\text{C}_{10}\text{H}_{16}\text{O}$, when the carbon atoms combined with nearly, but not quite, two equivalents of hydrogen, or a corresponding amount of some other element. At present the evidence is in favour of these isomeric bodies not having the same influence on light, which may serve to explain the difference of their rational composition or structure.

"On Black Deposits on Metals," by J. H. GLADSTONE, F.R.S.—If a piece of metal be immersed in the solution of another metal which it can displace, the latter metal immediately makes its appearance at myriads of points in a condition that does not reflect light; but as the most favourably circumstanced crystals grow, they acquire the optical properties of the massive metal, the period at which the change takes place depending partly on the nature of the metal and partly on the rapidity of its growth. This was illustrated in the case of platinum, palladium, iridium, bismuth, antimony, gold, copper, lead, silver, thallium, zinc, and cadmium. If zinc be immersed in a solution of copper sulphate, the black deposit is first copper, then some black zinc is deposited on the copper, as first shown by Dr. Russell, then this zinc is more or less oxidised; and according to the stage arrived at in this action is the ease with which a metallic streak is obtained on pressure, and the colour of the streak.

Dr. RUSSELL asked whether Dr. Gladstone had ever obtained a black deposit of copper absolutely free from zinc.

Dr. THORPE had employed the copper zinc couple of Messrs. Gladstone and Tribe for reducing nitric acid, and found that the black deposit alone was effective; hence he concluded it contained zinc.

Dr. GLADSTONE fully admitted that practically there was always more or less zinc in the black deposit of the couple, but it might be obtained at first with no perceptible amount of that metal, and the zinc of the washed black deposit might be removed by treating it with sulphate of copper, when it would still remain black.

"On a Specific Gravity Bottle for Inflammable Liquids," by A. TRIBE, F.C.S.—This consisted in a modification of that of Regnault, the narrow neck being graduated, instead of one mark being made in it. The advantage was that an inflammable liquor, or one that gave dense or injurious fumes in the air, might be quickly poured in without observing the particular height in the neck till the stopper had been inserted. It also afforded the opportunity of

bringing the liquor to a desired temperature after it was in the bottle. Of course the value of the graduations must be determined.

"On Derivatives of Codeine and Morphine," by C. R. A. WRIGHT, D.Sc., F.C.S.—This paper was a *résumé* of results obtained during the previous year in continuation of those brought before the Association on former occasions. Morphine gives rise, by treatment with sulphuric acid, to polymerides precisely analogous to those found from codeine under similar conditions; trimorphine and tetramorphine have been isolated, but dimorphine has not yet been found. Derivatives from these bodies by the action of hydrochloric acid have been obtained and studied. The sulphomorphide of Laurent and Gerhardt is only tetramorphine sulphate. By the action of hydrochloric acid on morphine a chlorinated product is formed; by further treatment this forms apomorphine and a new body. Under the same circumstances codeine gives rise to a chlorinated base, homologous with that from morphine; the further action gives rise, not to apomorphine, but a somewhat similar body containing more of the elements of water, i.e., intermediate between morphine and apomorphine. The action of zinc chloride on morphine has also been studied; the final products are apomorphine and an isomeric base of the tetra series, intermediate substances being found. The physiological properties of most of these new derivatives have been studied and some connections made out in certain cases between the composition and the physiological action.

A brief discussion followed, in which Drs. ARMSTRONG and MILLS took part.

INVESTIGATION OF THE FLUORESCENT AND ABSORPTION SPECTRA OF THE URANIUM SALTS.*

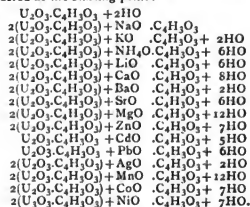
By HENRY MORTON, Ph.D.,
and H. CARRINGTON BOLTON, Ph.D.
(Continued from p. 116).

PART III.

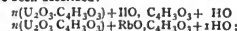
PASSING now to the detailed discussion of the various compounds, we will take these up in alphabetical order for the convenience of reference.

Uranic Acetates.

Uranic acetate combines with acetates of the bases RO to form a very large number of double salts. Of these there have been described, up to the present time, the following, including the uranic acetate, which may be considered as the starting-point:—



To these we have added the following, which now before been described:—



* Communicated by President Morton.

also the anhydrous uranic acetate, $U_2O_3C_4H_3O_3$, which we have prepared and studied.

It will be observed that in all of these compounds two molecules of uranic acetate combine with one molecule of the acetate of RO, except in the case of the salts of lead and of cadmium in which the ratio is 1:1.

Most of these salts crystallise very readily from acid solutions of equivalent weights of the mixed acetates; they vary considerably in stability, some, like the sodio-acetate, suffering no change at a temperature of $200^\circ C.$, and others, like the plumbo-uranic acetate, decomposing at $100^\circ C.$, or the argento-uranic acetate, which decomposes at 70° to $80^\circ C.$, or by exposure to sunlight.

Some crystallise out, on cooling, warm concentrated solutions, while others, as the lithium salt, are only obtained by evaporation over sulphuric acid.

On boiling solutions of these salts containing no free acid, uranates of the respective bases precipitate, and in many cases the same happens to a neutral solution on standing even in the cold.

All these salts we have prepared in a state of chemical purity, and have thoroughly examined as to their spectra of fluorescence and absorption, and have likewise studied the effects of heat in either temporarily or permanently modifying their properties in these connections.

In the course of these examinations we have recognised the existence of more than one hydrate of the same salt, which enables us to explain some of the discrepancies of authorities on this point.

Uranic Acetate (normal), $U_2O_3C_4H_3O_3 + 2HO$.

This substance fluoresces very brightly, different specimens, however, differing greatly in this respect, probably

appreciable with a strong light and wide opening to the slit of the spectroscope.

The brighter bands will show a very abrupt termination towards the more refrangible end, and shade off gradually so as to look like a series of short pieces of moulding illuminated from the violet side of the spectrum. No. 1 in Fig. 5 will give an idea of this, as well as of the positions of the various bands.

Measuring the edge of the bright bands at their upper or abrupt side, we get the following as the average of several sets of observations:—

Bands:—1.	2.	3.	4.	5.	6.	7.
37°0	43'8	51'6	60'7	70'4	80'2	90°0

The 8th band is too faint to show any definition on its edge, if it has any, and its measurement was therefore made at its brightest part, giving 90°6.

By turning the spectroscope obliquely on the bottle containing this salt, an absorption band at 107 can be distinguished with tolerable ease, but none above this can be well made out, and in fact, as regards this matter, the strongest contrast exists between the uranic acetates and its double salts. By crushing a few grains to a fine powder, with a little water, between slips of glass, we may, however, observe the absorption bands by transmitted light with reasonable facility, and then get a spectrum of a very curious character as regards the irregular spacing of its bands. No. 1 of Fig. 6 will give a good idea of this. Another noteworthy point is the very strong general absorption, which almost obliterates details of the spectrum, and makes it impossible to recognise any bands above one at about 135.

In solution this general absorption is decidedly increased, and the absorption bands are blended so that little can be done in the way of measuring them with ordinary means; we shall see, however, presently that this condition affords an important means of discrimination.

If we make a solution of the neutral acetate in water, and examine its absorption, we shall find a faint band at about 105, and some indication of one at about 117, but a very heavy general absorption over the entire region above the first-named band obliterating all variations of shade.

The addition of a little acetic or other strong acid will, however (while destroying the fluorescence of the solution), clear up its absorption spectrum in a remarkable manner, giving us such a one as is shown at No. 3 of Fig. 6, which we have reasons for regarding as the absorption spectrum of the double acetate of uranium and water. These reasons will be stated further on, when the necessary preliminary facts have been reviewed.

Anhydrous Uranic Acetate, $U_2O_3C_4H_3O_3$.

If the above normal uranic acetate is dried in a hot-water oven, at a temperature of $100^\circ C.$, for some hours, it becomes opaque, and of a lighter and purer yellow tint, and on examination is found to yield a fluorescent spectrum, the bands of which are like those of the normal salt, but are all displaced downward in the spectrum. No. 2 of Fig. 5 will show the arrangement of these bands. The brightness of the fluorescence is very much reduced, and probably for this reason—the first and last bands could not be made out with the apparatus at present in use.

By inclosing this substance in dry powder, between slips of glass, its absorption spectrum was observed with transmitted light, and is shown at No. 2 of Fig. 6. The general absorption is, however, even greater in this than in the case of the normal uranic acetate, and

FIG. 5.

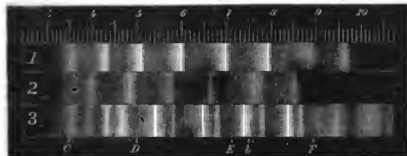
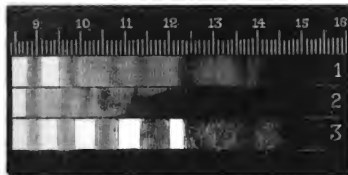


FIG. 6.



from the presence in certain cases of minute traces of foreign matter. Its solution also yields a very bright fluorescence, exceeding that of the nitrate, which is, however, decidedly reduced by the addition of a very minute quantity of alcohol, ether, glucose, or sucrose, and is destroyed by a very small amount of hydrochloric acid. The fluorescent light of the solution yields a continuous spectrum.

When examined with the spectroscope its fluorescent light emitted by the solid yields a system of eight bands. Of these the 1st and 7th are very faint, and the 8th only

thus the recognition of the higher bands is more difficult.

The Double Acetates.

The double acetates of uranium, as a class, give spectra which—while differing in a marked manner from that of the simple uranic acetate—have the most striking resemblance among themselves.

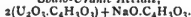
The fluorescent spectrum of the sodio-uranic acetate, shown in No. 3 of Fig. 1, is a type of a perfect double acetate spectrum, others differing from it only by lacking some of the fainter bands, and by some slight general displacement of all the bands up and down in the spectrum.

Taking the sodio-acetate, whose bands stand highest in the spectrum, as head of the list, the acetates would arrange themselves in the following order, noting for brevity simply the symbols of the distinguishing elements—Na, Li, K, Sr, Mg, Am, Zn, Rb, Il, Ba, Cd, Pb, Ca, Ni, Mn. At the same time it must be noted that between Am and Cd the progressive change is so gradual that the exact order cannot be insisted upon between any adjacent two, or even three in some cases.

The absorption spectra of the acetates, of which also that of the sodio-uranic acetate may be taken as the type, shift, as do their fluorescent spectra, marking again the very close relation which exists between these phenomena, while at the same time their independence is illustrated by the fact that in such cases as that of the bario-uranic acetate, where the fluorescence is exceedingly weak, and the cobalto-uranic acetate, where it is absent all together, the absorption spectrum is as well developed as in any other case.

All the double acetates, in fact, show their absorption spectra with very great ease, and most of the bands can be seen by simply directing the spectroscope obliquely towards the bottle containing the salt under examination, when the apparatus is arranged for the study of the absorption bands.

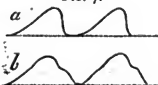
Sodio-Uranic Acetate,



This is the most brilliantly fluorescent of the uranic acetates, and yields a spectrum which it is easy to examine accurately, as a very narrow slit may be employed.

This spectrum differs entirely from that of the uranic acetate in several particulars. In the first place it has no abrupt or sharply defined termination to its bands, as has the simple acetate towards the more refrangible edge, and in the second place it has a decided secondary inflection of brightness on what may be called the upper flank of each band. Thus, if we were to represent these inflections of light by profiles, that of the acetate bands would be indicated by *a*, and those of the soda salt by *b* of the adjacent figure.

FIG. 7.



The positions of these bands as compared with those of the uranic acetate amounts to an upward displacement which brings them into the spaces between the others, and this, combined with their difference of character, produces a compound spectrum of singular beauty. The presence of this double spectrum reveals to us at a glance in most of the commercial uranic acetates the presence of the soda salt which is *not* specified on the label.

Another characteristic of the sodio-uranic acetate spectrum and of the double acetates generally, is that the space corresponding to the two lowest groups or bands is occupied by four narrow bands quite different in character from all above. This is well shown in No. 3

of Fig. 5, which represents at once the spectrum of this salt and of the hydro-uranic acetate, as we might call it, mentioned before.

The absorption spectrum of this salt is like others of its class, beautifully regular and well defined, being but little obscured by the general absorption which so often conceals the bands in other cases.

Each band is, moreover, composite in its structure, consisting of a narrow and abruptly terminated line, bordered by a much fainter shade, see No. 3, Fig. 6.

If we now examine the solution of this salt in a neutral state, we shall find exactly the same bright fluorescence, yielding a continuous spectrum and the same heavy general absorption with two obscure bands, that we noticed with the neutral uranic acetate. Moreover, if we add a strong acid, the fluorescence will be destroyed, and the spectrum cleared up exactly as with the above-named salt, and what is more, we shall find the same true for every one of the seventeen double acetates which we have so far examined. This spectrum, moreover, as regards the position and character of its bands, is not to be distinguished from that of the dry or anhydrous sodio-uranic acetate.

In their solid state all these salts yield spectra more or less different from this in the position of their bands, but in solution they are all alike, and the inference seems irresistible that we see in all of these solutions the spectrum of the same body.

The question then arises, what is this body? Before answering this, let us review some of the facts—(1) To produce this spectrum acetic acid must be added or set free by the addition of some other acid able to liberate it; (2) The spectrum produced is sensibly identical with that of the double acetate of sodium and uranium; (3) Previous experiments in freezing solutions have shown us that no change in a spectrum is to be expected from the mere act of "mechanical solution."

With these points before us it certainly seems probable that the body whose spectrum is here shown is a *double acetate of uranium and water or a hydro-uranic acetate*.

This, as a consequence, brings with it the conclusion that the uranic double acetates do not exist as such in solution, and as we find evidence of a parallel character in the case of the oxychlorides, sulphates, carbonates, &c., we may probably enunciate with safety the conclusion that the uranic double salts generally break up in solution into their respective "hydrates," or double salts, in which water is one of the bases. Various collateral points support this general view. Thus, the cobalt double acetate shows no fluorescence whatever, but its neutral solution fluoresces as brightly as that of the simple uranic acetate.

Many of the double acetates decompose in solution and crystallise out as separate salts.

Others, again, if neutral, precipitate as uranates until enough acetic acid is set free to hold the remainder (according to the view here proposed) as hydro-acetates.

The fact that the soda salt would have the smallest amount of inert matter in comparison with the active uranium except the supposed water salt, and has the highest position for its bands of all the acetates, should not be overlooked.

We have already noticed the effect which heat produces in displacing the fluorescent bands of the sodio-uranic acetate downwards in the spectrum. A series of careful observations showed that the absorption bands followed the same law.

The following measures of three bands will indicate the amount of this displacement:—

Bands.	3.	4.	5.
24° C. (75° F.) . . .	105.4	115.8	126.6
138° C. (280° F.) . . .	103.8	114.2	125.0

The solution of sodio-uranic acetate fluoresces very brightly, and yields a continuous spectrum when its light is examined with the spectroscop.

At a temperature of 49° C. (120° F.) this fluorescence is sensibly reduced, and at 83° C. (181.4° F.) there is

hardly a trace left. The addition of small quantities of ether, alcohol, glucose, sucrose, and glycerin greatly reduce the fluorescence of this solution, and a very small amount of hydrochloric acid destroys it entirely, but the former bodies do not have any effect in clearing up the absorption spectrum, as has been before noticed with acids generally, in the case of the uranic acetate, which, indeed, we believe to be the body here concerned.

The positions of bands as observed in a number of the double acetates are given in the following tables, in which the substances are arranged in alphabetical order for convenience or reference. The distinctive part of the name only is given, and the reader will therefore supply the words "uranic acetate" after each of these prefixes:—

POSITIONS OF THE CENTRES OF ABSORPTION BANDS IN THE SPECTRA OF THE URANIC DOUBLE ACETATES.

Bands.	1.	2.	3.	4.	5.	6.	7.
Ammonio- ..	—	—	105.4	115.8	127.2	137.2	149.0
Bario- ..	—	—	105.0	115.0	125.3	137.0	149.0
Calcio- ..	—	93.7	103.0	113.8	124.4	136.0	147.4
Cadmio- ..	—	—	103.0	114.2	124.8	136.0	148.6
Cobalto- ..	—	—	104.6	115.0	125.0	137.2	148.6
Lithio- ..	—	—	105.4	115.8	126.6	136.8	148.6
Magnésio- ..	—	—	104.2	114.2	124.8	136.1	148.2
Mangano- ..	—	—	102.4	113.4	125.0	136.5	147.0
Nickelo- ..	—	—	103.0	113.8	125.0	136.0	148.0
Plumbo- ..	—	—	102.6	113.8	124.4	135.8	148.6
Potassio- ..	—	—	104.6	115.4	125.9	137.2	149.4
Rubidio- ..	—	94.1	104.6	115.0	126.6	135.8	148.6
Sodio- ..	39.2	96.0	105.4	116.0	127.2	138.8	150.6
Strontio- ..	—	—	104.2	114.2	125.0	136.5	149.0
Thallio- ..	—	—	103.8	114.2	125.9	136.5	148.2
Zinco- ..	—	—	103.0	113.4	124.4	135.0	146.7

POSITIONS OF THE CENTRES OF FLUORESCENT BANDS IN THE SPECTRA OF THE URANIC DOUBLE ACETATES.

Bands.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Ammonio- ..	—	41.6	46.2	51.0	62.8	71.8	82.0	92.0	101.0	—
Bario- ..	—	—	45.2	53.4	62.4	72.0	82.3	92.4	100.6	—
Calcio- ..	—	37.0	40.8	45.6	53.4	61.9	71.7	81.4	91.7	100.2
Cadmio- ..	—	36.1	40.0	44.8	53.3	62.8	71.3	81.8	92.0	100.6
Cobalto- ..	—	—	—	—	—	—	—	—	—	—
Lithio- ..	—	—	41.4	46.0	54.3	63.3	71.9	82.0	93.7	102.6
Magnésio- ..	—	—	41.6	46.0	53.5	63.0	72.0	82.3	92.8	—
Mangano- ..	—	—	—	—	54.3	63.0	71.0	80.6	89.4	101.1
Nickelo- ..	—	—	—	45.2	53.0	62.0	70.8	81.4	91.3	100.6
Plumbo- ..	—	—	42.0	45.6	53.0	61.5	71.5	81.2	91.7	101.3
Potassio- ..	—	—	42.4	45.6	53.6	63.7	72.9	82.7	93.2	101.8
Rubidio- ..	—	—	—	—	53.8	61.3	70.0	80.6	93.2	—
Sodio- ..	39.0	40.0	44.0	48.0	55.3	64.0	73.8	83.8	94.4	103.8
Strontio- ..	—	—	—	46.0	54.3	63.3	72.9	81.4	92.0	—
Thallio- ..	—	—	—	45.6	53.4	62.8	71.7	82.7	92.0	—
Zinco- ..	—	—	42.0	45.6	54.3	63.3	72.0	81.8	92.4	—

Some special actions of certain salts require a further notice.

Thus, we found that when the magnesio-uranic acetate was allowed to crystallise in a desiccator it sometimes yielded crystals, which on exposure to a temperature of 100° lost a considerable amount of water and gave a continuous spectrum of fluorescence, and at others produced crystals which refused to part with any water at 100°, and when heated to a higher temperature lost water, but did not yield a continuous spectrum. Further investigation indicated that the first of these salts contained originally 12 atoms of water, and lost 4 atoms when dried at 100°, having, therefore, 8 atoms when it gave a continuous spectrum, and that the other salt contained originally 7 atoms of water.

These salts are still under investigation.

Wertheim gives the magnesio salt 8 atoms of water (*Journal für Prakt. Chemie*, xlix., 207). Weselsky gives it 12 atoms, and says that over sulphuric acid it loses 6 atoms, changing it into the salt described by Rammelsberg in his *Kristallogr. Chemie*, supplement band, p. 142.

Further examination is needed to clear up these discrepancies, but the above observations throw some light on the subject.

The lead salt, if dried at 100°, loses 3 H₂O, and ceases entirely to fluoresce; it will, however, dissolve in water,

but unless a little acid is added soon deposits plumbic uranate.

The lithium salt, however, by drying at 100° C., loses 3 atoms or half its water, but has its fluorescence strengthened thereby.

A specimen of strontio-uranic acetate dried at 100°, acted like the magnesio salt before mentioned, i.e., lost water and gave a continuous spectrum.

The zinc acetate, by drying at 100° C., loses CHO, and acquires a spectrum exceedingly like that of the normal uranic acetate, though the bands are broader. It may therefore, perhaps, decompose and form that salt and zinc acetate, the latter losing all its water. It is, however, curious that the uranic acetate should retain its water, as it here seems to even when heated to 150°.

(To be continued.)

ON THE CHLORINATION AND IODINATION OF ANTHRACEN.

By THOMAS BOLAS.

Action of Antimony Pentachloride and Excess of Chlorine on Anthracen.

ONE part of anthracen and three parts of powdered antimony were placed in a retort and exposed to the action of a slow stream of chlorine. When the antimony was converted into pentachloride heat was applied, and the mixture was made to boil, chlorine being still passed into it. This digestion was continued for several days, it being at first intended to continue the chlorination until the evolution of hydrochloric acid ceased; but as this gas was set free, in small quantities, long after the principal reaction had evidently terminated, the digestion was finally stopped, and the contents of the retort were treated with dilute hydrochloric acid. The portion which remained undissolved was found to be very much carbonised and to present the appearance of fragments of spongy charcoal, but on subjecting it to dry distillation a sublimate was obtained which presented a crystalline appearance. This partially dissolved in hot benzene, and the solution deposited crystalline crusts on cooling: these crusts—after one, two, and three crystallisations from benzene—melted at 236°, 247°, and 253° respectively. As the yield of this substance was but small, there appeared no prospect of obtaining it in a pure state without first chlorinating a considerable quantity of anthracen. Consequently this body remains at present for further investigation. The portion of the crude sublimed product which did not dissolve in hot benzene proved to be almost insoluble in boiling acetic acid, but it yielded, on sublimation, beautiful yellowish needles resembling sublimed anthrachinon. These needles melted at a temperature above 330°, and they were found to be almost insoluble in alcohol, benzene, ligroin, and carbon tetrachloride. The amount of chlorine contained in these crystals corresponded approximately with the formula C₁₄Cl₆H₄, but as the melting-point of this substance is so high, and considering that only a small proportion of it was obtained, I am inclined to regard it as derived from some foreign hydrocarbon contained in the anthracen employed. According to Fritzsche, anthracen melts at 210° to 212°, while dichloro-anthracen melts at 205°, and the melting-point of tetrachloro-anthracen is given as 220° by Graebe and Liebermann. Under these circumstances it would be surprising to find hexachloro-anthracen remaining unmelted at 330°. It is by no means improbable that the portion of the products which dissolves in hot benzene contains hexachloro-anthracen. This point I hope to elucidate shortly; and it is probable that, by employing a mixture of antimony chloride with some inert solvent, such as carbon tetrachloride, the violence of the action—especially that which takes place when the antimony first combines with chlorine—may be obviated, and that the carbonisation of the product may be considerably lessened.

Action of Iodine on Anthracen.

When anthracen is fused with excess of iodine, hydriodic acid is evolved, and on heating the mixture to its boiling-point the amount of hydriodic acid set free becomes considerable. If the mixture is now digested as long as hydriodic acid is evolved, and is then neutralised with soda, it will be found that the hydrocarbon has become transformed into a carbonised mass weighing rather more than the original anthracen. This charred mass, when heated in a tube, yields a small quantity of a sublimate consisting principally of free iodine, and it yields only a small portion of soluble matter to hot acetic acid or benzene. From this it is evident that the greater part of the anthracen is carbonised by long boiling with iodine.

In order to prevent the carbonisation of the greater part of the anthracen, 1 part of this hydrocarbon was carefully fused at 155° with 20 parts of iodine. As soon as the substances began to melt hydriodic acid was evolved, and when the fusion was complete and the materials were well mixed, the whole was cooled, powdered, and treated with soda solution. After the black residue had been washed and dried, it was extracted with boiling benzene, and it was found to yield a larger proportion of soluble matter than that obtained in the previous case, but the proportion not carbonised was still small.

When a solution of iodine in phenol (about 1 part to 6) is heated to its boiling-point no hydriodic acid is evolved, but if anthracen be added to the mixture, and heat be again applied, hydriodic acid is given off.

The facility with which iodine acts on the anthracen is remarkable, and there can be but little doubt that the first step of the reaction consists in the formation of addition-compounds or substitution-compounds which are afterwards decomposed. Towards the solution of this point I am now directing my attention, and I hope, either by modifying the action of the iodine by means of a solvent, or by the action of iodine in conjunction with an oxidising agent, to obtain some definite results.

September 13, 1873.

NOTES AND QUERIES.

Black-Lead.—I should feel much obliged if you would kindly inform me, through the columns of your valuable paper, of the process the plumbago has to undergo to make it into cakes of "black-lead" for polishing stoves as sold by Nixey and others.—A COUNTRY SUBSCRIBER.

German Yeast.—I find the best Dutch stills compose their gist in the proportion of 4 bushels of malt meal to 10 of rye meal; after fermentation, a considerable quantity of the meal and yeast will have settled to the bottom of the gyle tuns. Do the Germans, in making up their yeast for this country, add the settlings to the top yeast?—AKOMA.

Action of Pyrogallate of Potash on Nitrous Oxide.—Having seen it generally stated that pyrogallate of potash had the power of absorbing *free* oxygen, and thus indicating the difference between mixtures and chemical compounds, it occurred to me to try its action on pure dry nitrous oxide. A cylinder of the gas was collected over mercury, and two glass bulbs of about 1 c.c. capacity introduced into the gas. One of the bulbs contained pyrogallate in solution, the other caustic potash. The cylinder was then closed with the thumb and shaken until the bulbs were broken, and then replaced with the mouth under the mercury. A few days after, the mercury not having risen in the tube, the gas in the cylinder was tested, and, to my surprise, instantly extinguished a taper, and in general reached like nitrogen. Had the oxygen really been absorbed by the pyrogallate, the nitrogen would, of course, have occupied the original volume, since 2 vols. N₂O contain 2 vols. N. A second cylinder, filled at the same time, and treated with pyrogallate of potash as before, was left ten days over the mercury, then transferred to water. The water soon began to rise in the cylinder, and in ten days had absorbed 9-10ths of the gas. As nitrogen is not soluble in water, and nitrous oxide does not extinguish a taper, can some of your readers inform me what gas it was?—E. J. H., New York, August 29, 1873.

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SUPPLEMENT TO THE CHEMICAL NEWS.

VOL. XXVIII. No. 722.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopaedic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the *Chemical News*, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, August 25, 1873.

M. Zöllner's Theory of Solar Scoræ.—M. Faye.—This theory is, briefly, as follows:—The spots are scoræ produced by local cooling of the incandescent liquid which forms the solar globe. Their relatively low temperature gives rise to currents analogous to those about our coasts and islands; flow in the sun they do not alter. The lower currents flow perpendicularly to the sides of the islet from within outwards; the upper from without inwards. Hence a continual series of vertical movements, the horizontal axes of which are tangential to the contours of the scoræ. Naturally the solar radiation is partly suppressed by such an islet; and if the temperature sinks to the point of condensation of vapours in the atmosphere clouds are formed, whose figure depends on the upper currents flowing from all parts towards the vertical axis of the islet. They will especially be produced towards the central part, and the scoræ will appear as a dark nucleus with its *enclaire* of penumbra. This local cooling, and the descending movement of the atmosphere towards the interior, will explain the depression observed at the dark nucleus of spots, and the effects of perspective as they approach the edge of the disc. If the ascending currents outside of the islet are strong they will leap up and give the appearance of ordinary protuberances. As to the eruptive protuberances, they are due to a local diminution of atmospheric pressure. The gases included and compressed, or simply dissolved in the liquid mass, escape like the gas-bubbles in seltzer water when the cork is drawn. The movements of spots are explained by "trade-winds" from the poles to the equator. The component of this action in the direction of the parallels diminishes the velocity of rotation, and retards the spots more in regions near the pole than at the equator, where the action is nil. Large scoræ often break up and form several spots, the incandescent ocean appearing from below. Remark on this theory M. Faye points out that the spots on nearing the edge ought, according to it, to show a projection at the side of the sort of vase of which the scoræ forms the bottom; but there is nought of this, and the orifice becomes even with the edge of the disc. The depth of the spots has been measured, and found on an average three to four seconds. Everything indicates that the spots are cavities and not projections. On the other hand, the theory is more closely related to his (M. Faye's) own than P. Secchi's; both supposing a circulation and down rush of hydrogen; the axis, however, being according to the author vertical. And it is also preferable to the eruption theory in that it agrees with laws of movement of the spots, one of these being that

each spot follows the movement of the parallel in which it is, and if it passes into another parallel takes the movement of that. But then one would suppose that the islets of scoræ would be driven by the trade-winds supposed, towards the equator (like our ships). There is no such movement, and one even finds neighbouring spots which have limited movements in opposite directions, one towards the equator, the other towards the poles. The elliptic oscillation, too, has nothing in common with the displacement of floating bodies, and the phenomena of segmentation are hardly explained. The scoræ (if such there were) would doubtless be formed in the hottest regions; but, on the contrary, they appear in the zones nearest the equator, never at the poles. The spots do not appear beyond the 35th degree of latitude, while the protuberances (supposed to be produced by them) appear as far as the 70th. Lastly, consider the long and constant solar radiation. The sun being simply a liquefied mass would have been long since encrusted. If the conductivity of liquids and solids is so small that these scoræ resist the heat of the liquids for days, weeks, and even whole months, how are we to explain the enormous radiation of 1,200,000,000 calories per square metre of surface daily? A state of fluidity nearly gaseous is necessary to allow the play of ascending and descending currents to bring heat up from the depths of the solar mass and supply the superficial radiation during millions of years, and to allow of the progressive contraction of the greater portion of the mass repairing, in calories, a part of the secular loss. M. Faye considers that the circulation of solar hydrogen arises from a more general phenomenon than that supposed by M. Zöllner, viz., the vortical movements (with vertical axes) produced in the photosphere by its own special mode of rotation; and then radiation is connected with a still more general phenomenon, the mode of alimention of the photosphere.

Thoracic and Abdominal Phosphorescent Organs of *Cuyo* de Cuba (*Pyrophorus noctilucus*, *Elater noctilucus* L.).—MM. Robin and Laboulène.—The authors state that the light first appears in the centre, then spreads throughout. A yellow linear zone of adipose tissue at the exterior, at length becoming luminous, is yet not photogenic; it only reflects the light produced by the central part. But it does so, not only from its internal face but throughout its thickness, the action being favoured by the transparency and high refracting power of the fatty globules. The phenomena of dispersion and interference thus produced are the cause of the remarkable brilliancy appearing when the light from the centre reaches as far as this zone. As to the changes of molecular state in the tissue proper of the organ, the authors think the phosphorescent tissue produces a substance which slowly accumulates in the cells independently of all nervous influence, and of the same order with other secretions; and that only the act by which it is discharged is voluntary. The principle rendering the cells luminous behaved like the *noctiluca* extracted by Phipson. The abundance of urates in the cells makes it probable that uric acid results from the photospheric decomposition of the preceding coagulable compound. The large number of tracheæ in the apparatus is doubtless connected with the consumption of oxygen accompanying the phenomena.

Direct Demonstration of the Fundamental Principles of Thermo-Dynamics.—Continued extract from memoir by M. Ledieu.—This gives a direct demonstration of the amplified principle of Carnot.

Rapidity of Production of Phylloxera.—M. Lichtenstein.—The author considers that nine generations often appear in the three summer months. (A letter from M. Dumas describes the good effects of sulphide of carbon as a remedy against the insect.)

Spectrum of the Comet III. of 1873.—MM. Wolf and Rayet.—It consists of a continuous spectrum from the yellow to the violet, due partly to reflected solar light, and of two luminous bands, one in the green the other in the

blue, both diffuse towards violet. It is thought the comet may have a solid nucleus.

Spectrum of the Solar Atmosphere.—M. Rayet.—In studying a large faculae on the 16th August the author observed a peculiar mode of reversal of the line D. At a certain height on only of the two lines, the less refrangible, appeared luminous; and nearer the edge, when both lines were reversed, the less refrangible was always brighter than the other. The eruption at this point retained this character some time, for on the 24th the singular reversal was again observed. The author thinks it a general law that in a group of neighbouring lines of a substance it is the less refrangible that is most readily reversed.

Influence of Changes in Barometric Pressure on the Phenomena of Life.—Twelfth note by M. Bert.—When oxygen accumulates to about 30 per cent in the arterial blood (of a dog) it produces convulsions; and the fall of temperature which occurs indicates a profound change in internal nutrition. It is not that the blood becomes a poisonous substance through superoxidation, but that the excess of oxygen in the tissues themselves alters the chemical phenomena of nutrition. Similarly compressed oxygen hinders the germination of seeds, the putrefaction of fragments of muscle, the change of starch into sugar by saliva, the development of *Mycoderma aceti*, and a number of like phenomena.

Of Hay Asthma, or Hay Fever, as a Morbid Entity.—M. Decaisne.—He thinks the emanations from forage plants only play a very secondary part in the disorder, which attacks people whether exposed to these or not. It occurs in any season, and annual periodicity is not proved. It is "a catarrhal fever, influenced and modified in its various causes, in its progress, and, according to individual aptitude, by atmospheric conditions which produce acute affections of the bronchi."

On a Principle of Union of Universal Chemistry applicable to Organic Chemistry.—M. E. Martin.—The chemistry which we call universal comprehends the two electricities as material simple bodies, and establishes their properties, physical and chemical. It is founded, moreover, on the knowledge of the true ponderable elements, those which are at present recognised as such being mixed compounds; that is to say, being formed by a primary union, in definite proportions, of the true elements with the two simple imponderable bodies. According to universal chemistry, the elements, ponderable and imponderable, are divided into two classes according to their affinities. Those which possess the affinity of oxygen form the oxy class, comprising oxygen—which is not oxygen gas,—fluor, chlorine, bromine, iodine, and nitrogen, and by the simple imponderable body *electricité* (symbol, El), which is the so-called negative electricity. The basic class is formed by the elementary bodies, hydrogen—of which hydrogen gas is a compound,—carbon, sulphur, phosphorus, selenium, arsenic, boron, silicon, all the metals, and the imponderable body *ethericité* (Et), known as positive electricity. Bodies of the same class cannot unite directly with each other. There are four modes of chemical union, one of which only has been known hitherto.—1. Union of the two simple imponderable bodies among themselves, which yields as product light and heat. 2. Union of simple ponderable bodies of the basic class to the simple imponderable body of the oxy class, which gives combustible compounds, such as hydrogen gas, &c., and that of the simple ponderables of the oxy class to the imponderable of the basic, which yields oxygen and chlorine gases, &c. 3. Union of the compound bodies among themselves, which may take place in two distinct manners, without alteration in the constitution of the bodies which unite. In this manner unstable compounds are formed, as takes place in organic bodies. 4. Union between combustible and burning (*combustants*) bodies with double decomposition. The last-mentioned mode, in its two forms, the dry and the humid, is the only one hitherto known. (The substance

of this memoir was put forward by the author several years ago in a work entitled "Nouvelle Ecole Electro-Chimique").

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, Tome xxxii., No. 1, September 4, 1873.

This number contains no original chemical matter.

No. 2, September 11, 1873.

Horsky's Diffusion Apparatus.—This apparatus does away with the rasping process in the manufacture of beet-root sugar, dispenses with three-fourths of the manual labour, and extracts the saccharine matter completely. The yield of sugar obtained by the use of this arrangement has this season amounted to 8.5 per cent, an amount greatly superior to that obtained in neighbouring establishments where other processes for extraction are in use.

Dr. Jeannel's Horticultural Manure.—

Nitrate of ammonia	400 parts.
Biphosphate of ammonia	300 "
Nitrate of potash	250 "
Hydrochlorate of ammonia	50 "
Sulphate of lime	60 "
Sulphate of iron	40 "

Eudiometric Pipette.—M. Jean.—A modification of Regnault's apparatus, which would not be intelligible without the accompanying illustration.

Gases of Petroleum and of Resin.—M. Benavites.—A comparison of the illuminating power of these gases with common coal-gas.

Solidification of Nitrous Oxide.—M. T. Will.—The solidification of this body is readily obtained by passing a rapid current of air across the liquefied gas. Unlike liquefied carbonic acid the protoxide of nitrogen can be kept for a long time in a liquid state in open vessels. The protoxide of nitrogen which liquefies boils at -92°, and solidifies at -99°, so that the tension of its vapour is less than 1 atmosphere. The specific gravity of the liquid protoxide at 0° is 0.9004; its coefficient of dilatation is considerable, and it is insoluble in water.

New Series of Aromatic Hydrocarbons.—Th. Zincke.—By the reaction of powdered zinc upon a mixture of benzol and chloride of benzyl the author obtains, besides diphenyl-methan, two isomeric dibenzyl-benzines, C₂₀H₁₄.

New Method of Preparing Caustic Soda.—M. Helbig.—The crude lye is evaporated in cast-iron boilers. At a certain heat the cyanides contained in the pasty mass are decomposed with escape of ammonia, and deposition of carbon. When this point is reached the heat is raised to redness, and the mass becomes more fluid. A sheet-iron cover is then fitted upon the boiler, provided with an opening through which enters an iron pipe. This is plunged into the mass and air is forced in. The graphite which separates rises to the surface and may be collected. The mass is tested from time to time to see if the sulphur is perfectly oxidised. When this is the case the blast is stopped, the mass allowed to become clear, and run off as usual.

Examination of Grape Sugar and Milk Sugar.—M. Campani.—The author employs as reagent a concentrated solution of subnitrate of lead, mixed with a dilute solution of acetate of copper. The liquid to be tested is added to 5 c.c. of this solution and raised to a boil. If grape-sugar is present the mixture becomes coloured, and gives a yellow precipitate. Cane-sugar has no action. A dilute solution of milk-sugar behaves like grape-sugar. If the solutions of these sugars are concentrated the precipitates are brick-red.

Action of Soap Lyes on Incandescent Metals.—M. Barette.—The author finds that balls of red-hot metal are scarcely cooled by immersion in soap solutions. It appears as if the presence of soap in the water facilitated the assumption of the spheroidal state. Albumen, glycerin, and other organic matters have a similar action.

Bulletin de la Société Française de Photographie,
No. 8, 1873.

At a general meeting of the Society, August 1, 1873, a letter from M. Anthony, of New York, offering the following prizes, open to photographers of all nations:—100 dols. for the best bust of a lady; 100 dols. for the best head of a boy under six years of age; 100 dols. for the best head of a girl under six years of age; 100 dols. for the best group of two children under six years of age; 100 dols. for the best landscape. The proofs to be 16½ by 21½ centimetres, mounted on cards 25½ by 30½ centimetres.

M. Guilleminot presented to the Society a photographic trough made of hardened gutta-percha. This material resists elevated temperatures better than the ordinary gutta-percha.

M. Davanne gave an account of the photographic department of the Vienna Exhibition.

M. Champion gave the following as the result of his experiments on the preparation of gun-cotton:—The acid mixture consists of 2 measures of nitric acid at 40° B. (?), obtained by mixing common and fuming nitric acids. 3 measures of sulphuric acid at 66°. The mixture may be used either cold or at 40° C. The cotton is left in contact with the acid for three minutes, and the product washed till perfectly neutral.

M. H. Pellet gave an experimental demonstration of the process of M. J. Chrselsom for freezing silver baths from an excess of iodide of silver. He takes a common solution of nitrate of silver, to which are added a few c.c. of a solution of iodine in water slightly alcoholised. The liquid becomes yellow and turbid without precipitation. 2 or 3 drops of pure hydrochloric acid are then added. A precipitate of chloride of silver falls. The liquid is stirred, and on standing the supernatant solution contains the greatest part of the iodine added. The chloride of silver recently precipitated is decomposed by the iodine. Iodide of silver is formed and thrown down along with the excess of chloride of silver.

Sensitivity of Different Layers of Collodion.—M. Redon.—The author finds that opaque films of collodion receive an impression rapidly, and show an intense colouration, whilst transparent glassy films are impressed more slowly and feebly, and sometimes not at all.

Polychromic Photography.—Leon Vidal.—A repetition and expansion of the process briefly described in the last number, with an account of certain specimens of photographs in colours.

Revue Scientifique de la France et de l'Etranger,
September 6, 1873.

This number is taken up with an account of the Lyon meeting of the French Association for the Advancement of the Sciences. At one of the "Public Conferences" M. A. Gaudry delivered a lecture on the modern progress of chemical industry. He informed his audience that the amount of sulphuric acid manufactured annually in Europe amounts to 800,000,000 kilos, and would fill a canal 2 metres deep, 10 wide, and 25 to 30 kilometres in length. To yield this acid 800,000 tons of pyrites are yearly consumed. The condensation of the hydrochloric acid liberated in alkali works; the improvements of Mr. Weldon and Mr. Deacon in the manufacture of chlorine; the revolving soda-furnace; the extraction of potash as a secondary product in the manufacture of beet-root sugar; and the recent improvements in producing paper-pulp from wood, are among the principal points touched on in the remainder of this popular and able lecture.

Revue Hebdomadaire de Chimie Scientifique et Industrielle
par Ch. Mene, June 12, 1873.

This number contains no chemical matter.

Reimann's Fürber Zeitung, No. 29, 1873.

This number contains a notice of the tinctorial department of the Vienna Exhibition.

There are receipts for dyeing a dark grey on wool; a silver grey, an olive, and a bright olive on the same material.

For a scarlet on wool, woollen yarn, and woollen cloth, capable of bearing the milling process, the author gives the following formula:—To 10 lbs. of material take 1½ lbs. of oxalic acid, 7½ ozs. tin crystals, 3 ozs. flavin, and 1½ lb. cochineal.

There are also receipts for a lac scarlet, and a grain orange on wool; a catechu black on silk; a finish for cottons; a logwood blue for cotton-wool; a yellow on the same fibre; and an anilin green on cotton, which we quote.—For 10 lbs., allow the goods to soak three hours in a hot solution of ½ lb. tannin. The cotton thus mordanted is dyed in a recent cold solution of either iodine or methyl green acidulated with acetic acid; picric acid being added if a yellower tone is required.

There are also directions for a cheap logwood blue on cottons, and a reseda on old white silks produced by means of quercitron after mordanting with nitrate of iron.

There is a notice of Lamy's patent for brown on cotton by printing upon the goods nitrate, acetate, or hydrochlorate of naphthylamin with chloride of potash, a salt of copper, or hydrofluosilicic acid. The calico is then exposed to the air, and passed first through an acidulated bath of chromate of potash, and finally through an alkaline solution. The brown is equal in permanence to an anilin black.

Dufrénil proposes to pass tissues which are liable to be exposed to wet through a dilute solution of tannin, and then through chromate of potash till they turn brown, when they are washed and dried.

For an antichlore, sulphate of soda is recommended as preferable to the hyposulphite, which generally leaves a yellowish deposit of sulphur in the fibre.

In Lauth's process for fixing anilin green on wool by working in a bath of hyposulphite acidified with hydrochloric acid, an addition of alum is recommended to restore the elasticity of the wool, and free it from a smeary handle. The following two receipts for soap are given by a manufacturer of silicate of soda. For a toilet soap take 150 lbs. cocoa-nut oil; 50 lbs. lye at 40 per cent; 50 lbs. silicate of soda; and 5 lbs. of glycerin. For a fuller's soap take of fat 100 lbs.; potash lye at 30 per cent, 10 lbs.; potato starch, 10 lbs. in 20 lbs. of water; and 10 to 12 lbs. of silicate of soda at 30 per cent. Here there are 88 lbs. of adulterants to 100 lbs. of fat. Such soaps cannot be distinguished from genuine kinds by mere inspection. In order to dye an anilin black on yarn it is recommended to precipitate peroxide of manganese on the fibre, and then treat with anilin black.

No. 30, 1873.

This number contains receipts for a reddish drab grey on wool and woollen yarns; for a darker shade on the same materials; a reddish mode drab; a red-brown on wool and yarns; a blackish violet, a dark dahlia, a mulberry and an olive-brown on woollen piece-goods; a bright green capable of bearing milling on woollen yarn; for printing a fast steam black on wool; for a bright and fast green on cotton; a fine and cheap reddish brown on woollen yarn; for dyeing stiffened cotton yarns; and for black on linen yarn.

Rave proposes to treat dye-woods with soda or lime, and precipitates the solution with hydrochloric acid. The precipitated colour is sold as paste or powder.

Leather can be tanned in six days with a mixture of 10 parts tobacco root, 60 parts catechu, and 30 parts sumac.

The following receipt has been patented for scarlets on cotton:—2 lbs. solution of lac, 1½ lbs. of gum, 1 lb. tin crystals, 1 lb. oxalic acid, 8 quarts of water, and 1 quart decoction of oak-bark.

No. 31, 1873.

This number contains a list of the manufacturers of tinctorial chemicals to whom prizes have been awarded at

the Vienna Exhibition. We find no English name in the catalogue.

There are receipts for dyeing wool a bright green; for a finish for pack-thread; for a reseda on ganappe; a brown on silk; a printing black on cotton yarn; a blue-black on old cotton, velvets, and velveteens; a chamois and rose on old goods with cotton warps, saffranin on a sumach mordant being recommended for the latter; a black on mixed woollen and silk; a dark green on wool; a cheap violet on woollen piece-goods. For this the author recommends per 100 lbs. of cloth to boil for an hour-and-a-half with 2½ lbs. chromate of potash, 1½ lbs. blue vitriol, & 1 lb. oxalic acid, and 2½ lbs. sulphuric acid. The cloth is either allowed to cool in the decoction, or rinsed at once, and dyed in a fresh bath with 40 lbs. of logwood, 10 lbs. camwood, and 2½ lbs. of orchil, boiling for one hour. There are also receipts for a chestnut and a scarlet on wool, and for printing a black on flamed woollens. The editor extracts from a contemporary the following formula for a yellow:—"To an armful of woollen yarn take three table-spoonfuls of tin crystals, a saucer-full of flavin, and a milkpout full of oxalic acid. The whole is allowed to boil up, and so much water added that the operator can bear his tongue in the bath. The yarn is then entered, the heat raised to a boil, and the goods worked while the Lord's Prayer can be repeated twenty times!" Dr. Reimann, very pardonably, adds a sarcastic comment on such a gem of technological literature.

For bleaching wool the bisulphite of soda is proposed dissolved in water, and mixed with two-fifths its weight of hydrochloric acid.

Mahogany and rosewood yield a colouring matter resembling catechu. The rasped woods are roasted like starch, then extracted with water, and the liquid evaporated to the consistence of a syrup, or to dryness.

MISCELLANEOUS.

British Association for the Advancement of Science.—The following is a list of the papers read before Section B (Chemical Science) at the Bradford meeting:—

The President's Address.

Report on the Chemical Constitution and Optical Properties of Essential Oils.

J. H. Gladstone, F.R.S.—On Black Deposits on Metals.

A. Tribe, F.C.S.—On a Specific Gravity Bottle for Inflammable Liquids.

W. H. Pike.—On the Homologues of Oxaluric Acid.

C. R. A. Wright, D.Sc., F.C.S.—On Derivatives of Codeine and Morphine.

Professor Williamson, F.R.S.—Report of the Committee for Superintending the Monthly Reports of the Progress of Chemistry.

Professor G. C. Foster, F.R.S.—Report on Siemens's Pyrometer.

W. Chandler Roberts, F.C.S.—Report on the Method of Making Gold Assays, and of Stating the Results thereof.

J. Dewar, F.R.S.E.—Report on High Temperatures.

A. Vernon Harcourt, F.R.S., and P. W. Fison, F.C.S.—On a Continuous Process for Purifying Coal-gas, and Obtaining Sulphur and Ammonium Sulphate.

C. J. Woodward, B.Sc.—A New Form of Gas Generator.

J. Spiller, F.C.S.—An Artificial Magnetite.

Dr. Paul and A. D. Cowenly, F.C.S.—On the Valuation of Commercial Crude Anthracene.

J. Norman Lockyer, F.R.S.—Note on the Elements in the Sun.

R. B. Grantham, C.E.—Report of the Committee on Sewage.

W. T. McGowan.—On the Sewage of Manufacturing Towns.

W. Chandler Roberts, F.C.S.—On Horn Silver.

Dr. A. Schafarik.—On the Constitution of some Silicates.

Professor Crum-Brown, F.R.S.E.—On the Action of Sulphide of Methyl on Bromoacetic Acid.

Charles Horner.—On the Spectra of certain Boric and Phosphoric Acid Blowpipe Beads.

Alfred H. Allen, F.C.S.—On the Detection of the Alteration of Tea.

Alfred H. Allen, F.C.S.—On the Action of Sulphuric Acid on Ethylanilin and Dimethylanilin.

Alfred H. Allen, F.C.S.—Note on Cresol Derivatives.

Dr. H. E. Armstrong.—On Alpha- and Beta-Naphthyllic Sulphide.

Place of Meeting for Next Year.—The meeting next year will be held at Belfast, commencing on August 19. President Elect—Professor Tyndall, D.C.L., F.R.S., &c.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the utilization of the waste heat from coke ovens for the manufacture of soda ash, caustic soda, and for other similar purposes. Hugh Williams, Wigan, Lancashire. January 23, 1873.—No. 268. My invention consists principally in arranging two or more coke ovens side by side, in such a manner that their dues unite in one chamber, and charging and working such coke oven alternately or in succession, and in employing the heat and gases evolved therefrom in a secondary furnace adjoining the said coke ovens for the manufacture of soda ash, caustic soda, and other similar manufacturing purposes.

Improvements in the purification of coal-gas, and in the production of alkaline sulphides to be employed for such purpose. Robert Hogarth Patterson, Hammermill, Middlesex. January 23, 1873.—No. 274. This invention relates, firstly, to the production of alkaline sulphides (to be subsequently employed in the purification of coal-gas, either in the manner described in my Patent, No. 19, 1872, July 20, 1872, or otherwise), by decarbonating impure coal-gas—that is, gas containing carbonic acid and sulphuretted hydrogen—in alkaline washers or scrubbers or in lime-purifiers in such manner that, while the carbonic acid is arrested in the said washers, scrubbers, or purifiers, sulphuretted hydrogen is driven forward, and converts alkaline substances, such as potash or ammonia, ammoniacal liquor, or gas liquor, contained in subsequent vessels, into sulphides. I also employ the said process for the purpose of more highly sulphuretting gas liquor, whether decarbonated or not, so as to render the said liquor an efficient material for purifying coal-gas from sulphur contained therein in other forms than that of sulphuretted hydrogen. This invention relates, secondly, to a system of purification whereby the elimination of carbonic acid from coal-gas is effected by means of lime and alkalies before the said gas is passed through vessels containing alkaline sulphides, either in a solid or in a fluid form, with a view to purify the gas from sulphur contained therein in other forms than sulphuretted hydrogen.

Improvements of soup-farina. Edward Heinson Huch, merchant, Brunswick, Germany. January 24, 1873.—No. 288. This provisional specification describes dissolving extract of meat in salt water, and adding food of various kinds.

An improved mode of process for obtaining fertilising substances. Major-General Henry Young Darracott Scott, C.B., Ealing, Middlesex. January 25, 1873.—No. 295. The object of this invention is the manufacture of precipitated phosphates by the addition to clarified sewage water of impure phosphatic substances, such as coprolites, dissolved in acid.

Improvements in the torrefaction of animal substances for the purpose of manufacturing manure therefrom, and in the apparatus or means employed therein. John Henry Johnson, 47, Lincoln's Inn Fields, Middlesex. (A communication from the firm of Coignet, Son, and Co., Paris). January 25, 1873.—No. 305. This invention consists in torrefying and dissolving solid and liquid substances by the direct action in closed chambers of gases superheated to a temperature of about 550° F. Also in first drying the substances by the direct contact of gases heated to about 350° F., and then torrefying as above described. Also in cooling the torrefying mass by the application thereto of jets of water or saline solutions.

A new and improved artificial stone or cement to be used in aquatic or other buildings, also moulded and made applicable to ornamental, architectural, and other purposes. Henry Adrien Bonnevillie, patent agent, 6, Piccadilly, Middlesex. (A communication from Messrs. Schenck, Baronet, and Hayck, acting as administrators of the company known as Weiss Cement Actien Gesellschaft, two persons resident at Vienna, Austria). January 27, 1873.—No. 310. This invention relates to the manufacturing of a water mortar or an arrangement in using the dolomite or magnesian stones or the minerals which contain at least 25 per cent of $MgCO_3$, or the productions of chemical fabrication, which are combinations of magnesia, and which can be reduced by heat.

Improved processes and furnace with appliances for the economical production of baryta. Thomas James Smith, of the firm of Robertson, Brooman, and Co., patent agents, 165, Fleet Street, London. (A communication from Cyprien Marie Tessie du Motay, chemist, Paris). January 28, 1873.—No. 328. This refers to an arrangement for the employment of a solid or gaseous combustibles for the transformation by the dry method of sulphate of baryta into sulphuret of barium and of carbonate of baryta into baryta.

THE CHEMICAL NEWS.

VOL. XXVIII. No. 723.

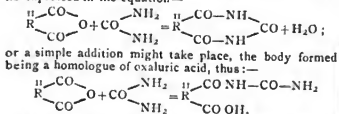
BRITISH ASSOCIATION FOR THE ADVANCEMENT
OF SCIENCE.

BRADFORD MEETING, 1873.

SECTION B.—CHEMICAL SCIENCE.

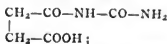
PRESIDENT, DR. W. J. RUSSELL, F.R.S.

"On several Homologues of Oxaluric Acid," by W. H. PIKE.—The ease with which the anhydrides of the dibasic acids enter into reaction with ammonia and the substituted ammonias, gave considerable reason to expect a similar reaction with urea. The reaction in this case might be expected to take place in one of two ways: either a body homologous with barbituric acid would be formed, as expressed in the equation—



As far as my experiments extend, the second equation expresses the reaction which takes place.

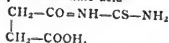
Succinic Anhydride with Urea.—Urea, heated with succinic anhydride in the proportion of their molecular weights to 120° to 130° C., dissolves in the fused anhydride to a thick oily liquid, which in a short time becomes solid with considerable reaction. The raw product thus obtained is powdered, and, after washing with cold alcohol to remove unaltered anhydride, re-crystallised from water. The analysis gave numbers which agree with those calculated for the formula, $\text{C}_5\text{H}_9\text{N}_2\text{O}_4$. The acid crystallises from water in small brilliant scales, which, when rapidly heated, fuse under complete decomposition at 203° to 204° C. It is nearly insoluble in cold water and alcohol; perfectly so in ether, chloroform, and bisulphide of carbon; moderately soluble in boiling water and glacial acetic acid. In concentrated sulphuric acid it is at once dissolved, and is precipitated entirely unaltered on dilution. It forms easily soluble salts with the alkalis and alkaline earth. The silver and lead salts are white crystalline precipitates, which are nearly insoluble in boiling water. The silver salt gave numbers on analysis which correspond with those calculated for the formula $\text{C}_5\text{H}_7\text{AgN}_2\text{O}_4$. The constitution of this acid will probably be—



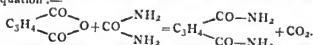
I have therefore named it succino-carbaminic acid.

Succinic Anhydride with Sulpho-Carbamid.—Succinic anhydride enters into combination with sulpho-carbamid with the same ease as with urea. Owing to the higher fusing-point of the sulpho-carbamid, the heat must be raised somewhat higher (about 150° C.) before the mixture is completely fused; it then soon becomes solid, as in the previous case. The raw product is washed with alcohol and crystallised from water. It forms a slightly yellow-coloured crystalline powder, which possesses similar properties to those of the preceding compound. It fuses at 210° to 211° C. It is somewhat less soluble in boiling water and acetic acid; in cold water, alcohol, and ether, absolutely insoluble. Sulphuric acid also dissolves it, without alteration, in considerable quantity. It forms

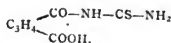
with the alkalis easily soluble salts, and with lead and silver white precipitates, which blacken if heated. The analysis gave numbers which agree with those calculated for the formula $\text{C}_5\text{H}_7\text{N}_2\text{O}_5\text{S}$. This compound will thus be succino-sulpho-carbaminic acid—



Citraconic Anhydride with Urea.—I have not as yet succeeded in obtaining any combination between citraconic anhydride and urea when these two bodies are heated to 115° C. Carbonic acid is given off, and citraconamid is formed, most probably as expressed by the following equation:—



Citraconic Anhydride with Sulpho-Carbamid.—Citraconic anhydride, however, combines at once with sulpho-carbamid to form a body which may be named citracon-sulpho-carbaminic acid. It may be purified in the same way as the preceding compounds, which in all its properties it closely resembles. It fuses at 222° to 223° C. under complete decomposition; it also gives easily soluble salts with the alkalis, and with nitrate of silver and of lead insoluble white precipitates which blacken on heating. The numbers obtained on analysis show that this acid possesses the formula $\text{C}_6\text{H}_8\text{N}_2\text{O}_5\text{S}$, the probable constitution being—



Lactic with Urea and with Sulpho-carbamid.—Neither with urea nor with sulpho-carbamid could I obtain from lactic any combination analogous to the preceding. Lactic, when heated with urea, gave off carbonic acid and formed a substance the examination of which is not complete; with sulpho-carbamid the same body was formed, with separation of oxysulphide of carbon.

I also heated succinic anhydride with sulpho-carbanilide, but this body decomposes, under the influence of the anhydride, into phenyl-mustard oil and anilin, which then acts on the anhydride.

I propose to continue the study of the action of the anhydrides of other dibasic acids on urea and on sulpho-carbamid.

"Report of the Committee on Siemens's Pyrometer."—The following is the substance of the report presented to Section B, by Professor G. C. FOSTER, F.R.S.:—Siemens's Pyrometer is an instrument for the measurement of high temperatures depending upon the change produced by heat in the resistance opposed by platinum to the passage of an electric current. It consists essentially of a coil of platinum wire, suitably protected, and so arranged that its resistance can be measured while it is exposed to the temperature it is desired to ascertain. The importance of possessing some trustworthy method of measuring temperatures beyond the range of the air-thermometer induced the British Association to appoint a committee to examine and report upon the merits of this instrument.

The first step was evidently to test the electrical permanence of the pyrometer, and the attention of the committee has as yet been confined to the examination of this point. At the Brighton Meeting in 1872, it was reported by them that a pyrometer whose resistance was, to begin with, 9,917 B. A. units at 10° C., had a resistance of 10,502 at the same temperature, after having been repeatedly heated to redness. This change was found by Professor Williamson to be, in all probability, due to chemical alteration of the platinum caused by the combined action of the silica of the porcelain core on which the wire was coiled and of the reducing atmosphere existing inside the protecting wrought-iron tube. The committee have, since then, been supplied by Mr.

Siemens with two new pyrometers, in which, with the hope of preventing the alteration previously found, a platinum tube has been introduced, surrounding the coil and separating it from the outer iron case. This addition, however, does not seem to have caused any considerable improvement, the resistance of one of the pyrometers having been at first $9\cdot20$ at 10° , and, after being twice heated to redness, $10\cdot462$ at the same temperature; the other had, to begin with, the resistance $9\cdot88$ at 10° , and after one heating its resistance was $10\cdot465$ at the same temperature. It is, however, quite possible that little or no further change would be found to occur after the first few heatings, but the committee have been unable during the past year to make sufficiently numerous experiments to enable them to form an opinion on this point. They therefore ask to be re-appointed, and for a renewal of the unexpended grant of £30, which was originally placed at their disposal.

"Report on the Method of Making Gold Assays, and of stating the results thereof," by W. CHANDLER ROBERTS, F.C.S.—The attention of the Committee was first directed to a series of experiments which were instituted with a view to ascertain to what extent the weight of pieces of pure gold and of alloys, synthetically prepared, would be affected by submitting them to the process of assaying, and consequently how far the results of assay operations are trustworthy. These results showed that the maximum error was only 1-100th per cent of the original weight of the assay piece, and consequently that the result obtained by assaying gold represents the composition of the portion of metal under examination to the 1-10,000th part, a fact which will doubtless appear remarkable to all who are accustomed to the ordinary methods of quantitative analysis.

The committee are not unmindful that, although it is possible to attain this high degree of accuracy, it is nevertheless well known that a comparison of the assay reports of the different assayers as to the composition of the same ingot might often disclose discrepancies of 5-10,000 parts.

Thus portions of metal from nineteen gold ingots were assayed by the Mint Assayer and were then sent to five assayers, each of whom furnished an independent report. Two assayers alone agreed as to the value in each of 15 ingots, in 3 ingots three assayers were in accordance, while in one instance all the assay reports differed; and, viewing the reports generally, the discrepancies varied from 4-10,000 parts to 1 part of fine gold in 1000 of the alloy, or an average deviation of 6-10,000 parts.

These small variations assume serious proportions when they affect the value of large quantities of bullion; for instance, the value of gold coined in the Mint during the past year was £15,200,000, and a persistent error in the assay reports of only 1-10,000th part would have been attended with a gain or loss to the department of no less than £1500. The Committee have entered upon the following investigations, in the hope of being able to define the condition under which errors arise:—

The method of gold assaying, as practised in the Mint, is given in the Appendix, and the method has been deliberately adopted by all assayers with slight variations of manipulation, which have not as yet been minutely examined, as the Committee considered that when widely divergent results are obtained, the gold employed by one or other of the assayers is impure, and that either the amount of impurity has not been ascertained with accuracy, or that it altogether escapes detection. It follows, therefore, that the weight of the "cornets," when compared with the initial weight, the portion of metal operated upon appears to indicate the presence of an amount of gold which is in excess of the true amount of precious metal present in the alloy.

The Committee obtained specimens of gold from different sources, and tested them side by side with gold prepared in accordance with the directions of the Lords Commissioners of Her Majesty's Treasury, by the Chemist of the Mint for use as a standard trial plate in testing the

coinage. Great care was taken in the preparation of this gold, 80 ounces of which were precipitated from no less than 100 gallons of chloride of gold, and experiments have already shown that it is very pure. The Committee propose that they adopt it as the basis for a new series of comparisons.

"High Temperatures."—Mr. J. DEWAR, F.R.S.E., stated the substance of a report on high temperatures. It had been thought that, as a low red heat brought out only the red end of the spectrum, and the spectrum gradually extended towards the violet end as the temperature rose, this fact might be used as a means of measuring temperatures. The difficulty, however, in employing this method was that for a great portion of its length the growth of the spectrum was very rapid. There also appeared at the beginning of the spectrum a grey light, which prevented the red ray from being seen. Then the human eye was much more sensitive to some parts of the spectrum than to others. This difference between the length of the spectrum and the range of human vision would cause a mis-estimation of temperature unless the spectrum could be registered by some photographic process. He (the speaker) had, therefore, thought it better to reconsider the object of the grant made by the Association, and report rather upon the increase in the quantity of light than in the length of the spectrum. The relation between the intensity of the light evolved and the heat indicated had been already well established, though their relative rate of increase had not been ascertained. Becquerel concluded that the intensity of the light was, in mathematical language, a function of the heat, growing with very great rapidity in proportion to the latter. He came to this conclusion because the radiation of heat increases with the temperature by the same law. The experiments made by himself had led him to the conclusion that at temperatures of upwards of 1000 degrees the function was a parabolic, that is, that the temperature increases as the square of the light. He said above 1000 degrees, because that temperature was required to eliminate the effects arising from the growth in the length of the spectrum. This parabolic function gave a much slower increase of light than was estimated by Becquerel. Experiments on radiant heat had also been conducted by him (the speaker) with a view to measuring high temperatures by a method similar to that which we employed to measure the radiation of the sun itself. A portion of the surface of the heated body whose temperature was to be ascertained was caused to radiate its heat on the blackened surface of a cube containing water, and from the number of degrees which the temperature of the water rose in a fixed time, the heat of the radiant body was concluded. Whilst on this line of experiment it was found that MM. Dulong and Petit's law did not hold good above a low red heat, the explanation probably being that the violet light waves did not carry so much energy as the larger red ones.—Mr. DEWAR, who had at considerable length and with much facility of illustration, explained the results of the report instead of reading it, concluded amidst some applause.

Dr. GLADSTONE said the chief difficulty that had occurred to him with regard to the measurement of high temperatures by the spectrum was that it would be far from easy to determine where one colour ended and another began, and this very difficulty had proved insuperable. Even the same spectrum was different in appearance to different eyes. When he was experimenting in association with the late Sir D. Brewster he noticed that the latter could see rays of much lower refrangibility than he (the speaker) could, whilst he could see a greater portion of the violet end of the spectrum than could Sir David Brewster. However, by the several methods which had that day been explained—including the Siemens pyrometer—they were placed in a position to make comparison of one with another, and thus obtain a reliable result.—A few further remarks were made (it being observed that although they had several means of comparing

high temperatures relatively to each other, there were as yet no means of ascertaining the absolute temperature registered by pyrometers, and the President closed the discussion by a hope that the committee would continue its investigations next year.

"On a Continuous Process for Purifying Coal Gas from Sulphuretted Hydrogen and Ammonia, and for Extracting Sulphur and Ammoniacal Salts," by A. VERNON HARCOURT, F.R.S., and F. W. FISON, F.C.S.—The introduction of "oxide" for purifying "foul gas" has furnished the gas-maker with a process which might fairly be described as continuous when compared with the use of lime. But after the oxide has been alternately sulphurised and revived twenty or thirty times, it is rendered inert by the accumulation of sulphur, and fresh oxide has to be substituted for it. The spent material, consisting of a mixture of oxide and sulphur in about equal bulks, is either burnt like pyrites on the hearth of the vitriol-maker, or it is heated until the sulphur is separated by sublimation. In either case the oxide itself is rendered anhydrous by the action of heat, and cannot be used again for gas purification.

Ammonia is most commonly removed from gas by "scrubbing," and the construction of scrubbers and the mode of working them has been brought to great perfection. Nevertheless this process is liable to some objections. The scrubbers are bulky erections, and the cleansing of them, which is generally found to be necessary from time to time, is a troublesome operation. Also, the ammonia is not obtained in the most portable and saleable form, as a solid salt, but as a solution containing perhaps 20 ozs. of ammonia in a gallon of water. Although the volume of water used in scrubbing gas is relatively very small, it cannot fail to produce some reduction of illuminating power, since olefant gas is far from insoluble, and a more copious washing reduces the illuminating power in a very noticeable degree. The use of coppers, or of sulphuric acid and sawdust, or of other substances that may be employed in a similar manner, is commonly designed to supplement the use of scrubbers, and requires the appropriation of a distinct set of purifiers, or at any rate, the material used to stop ammonia must be kept separate from that which is used to stop sulphuretted hydrogen.

The extraction of sulphur from the spent oxide, and the manufacture of ammoniacal salts from the liquor, are operations which the gas manufacturer generally makes over as too troublesome for him to undertake to the manufacturing chemist. The process about to be described is one which we believe it will be both advantageous and easy for the gas manufacturer to conduct upon his works. It effects the removal of sulphuretted hydrogen and of ammonia simultaneously, and yields sulphur and sulphate of ammonia in a nearly pure state. It renders the erection of scrubbers, and pumping, and the washing of gas with water unnecessary. It restores the oxide, from which sulphur and sulphate of ammonia have been extracted, to the purifiers in the form of pure hydrated oxide, so that the same oxide may be used for an indefinite time. The new process is at once applicable wherever oxide is, or can be, used as the agent of purification, the only differences in the mode of working being that the oxide, during revivification, is moistened with a solution of ferric sulphate (persulphate of iron), and that a portion of the oxide is removed from time to time, and treated in the following manner:—It is first extracted with water, by the use of an arrangement similar to that employed in the extraction of black-ash. The soluble salts are sulphate of ammonia, formed in the purifiers by the reaction of ammonia and ferric sulphate, and, in smaller quantities, sulphocyanide, hyposulphite, and, probably, other salts of ammonia. This extract is mixed with a small excess of sulphuric acid, and yields, when concentrated by evaporation, crystals of sulphate of ammonia. The remainder of the substance is then boiled with dilute sulphuric acid, which dissolves the oxide, and

leaves a residue of sulphur. The actual process of extraction by acid consists in treating the substance successively, (1) with a solution of ferric sulphate, containing some free sulphuric acid; (2), with a more dilute solution of ferric sulphate to which sulphuric acid has been added; (3 and 4), with more dilute solutions of ferric sulphate, all these liquids being the produce of a former extraction; and (5), with water. The liquid resulting from the first of the treatments enumerated above is a strong solution of ferric sulphate, which is used, as already mentioned, by being mixed with the charge of oxide before it is replaced in the purifier. The residue, after the final washing, consists almost entirely of sulphur, and requires only to be dried. It will be evident that all the oxide which has been freed from sulphate of ammonia and sulphur by this treatment passes into the condition of ferric sulphate, and, in this condition, is replaced in the purifier. There it again becomes oxide by the action upon it of the ammonia of the gas, which it completely removes, while the ammonia is fixed as sulphate.

In order to obtain by one operation all the ammonia found in the retorts, and to ensure the passage into the purifiers of a quantity of ammonia sufficient to neutralise all the acid employed in dissolving the oxide, we propose further to run the liquor from the condensers into a chest heated by steam, through the top of which a current of gas passes, which is drawn from beyond the exhaustor, and re-enters the main leading to the condensers. By a suitable arrangement, the condensed liquor may run continuously through this chest, passing off after it has been heated in the current of purified gas.

"On the Valuation of Commercial Crude Anthracene," by DR. PAUL and A. J. COWNLEY.—The authors proposed for the present unsatisfactory method of testing crude anthracene, that anthraquinone should be used as a basis of valuation. They had found that 178 parts of good anthracene were equivalent to 208 parts of anthraquinone. The melting-point for anthraquinone they had found to be 276°. The agent they recommended for oxidising the anthracene was a solution of chromic anhydride in glacial acetic acid. In reply to Drs. ARMSTRONG and MILLS, Dr. PAUL said it would take three days to make an estimation of anthracene, and that he could not vouch for the absolute purity of the anthracene he used as a standard.

Mr. J. NORMAN LOCKYER, F.R.S., read a paper "On the Elements in the Sun." He did not come before the section as a chemist, but as an amateur interested in certain inquiries which day by day seemed to be breaking out in a curious way in a chemical direction; and in prosecuting those inquiries he sought the assistance of the chemists. He believed that the more they knew about the sun and stars, the better it would be for astronomers and physicists and chemists as well. Mr. Lockyer then explained the processes by which, with the aid of the spectrum analysis, he was able to discover the composition of the sun. Mr. Huggins and Father Secchi had both paid great attention to the subject; and from the result of their observations and his own he had come to the following conclusions:—First, the absorption of some elementary and compound gases was limited to the most refrangible part of the spectrum when the gases were rare, crept gradually into the visible violet part and finally to the red end of the spectrum as the pressure was increased. Second, the absorption of the photospheric light, and therefore the temperature of the photosphere of the sun was much greater than had been supposed. Third, the lines of compound metallic vapours lay generally in the red end of the spectrum, and this held good for absorption in the case of aqueous vapour. Such spectra, like those of the metalloids, were separated spectroscopically from those of the metallic elements by their columnar or banded structure. Fourth, there were, in all probability, no compounds ordinarily present in the sun's reversing layer. Fifth, when a metallic compound vapour was dissociated by the spark, the band spectrum died out, and the elemental lines came in according to the degree of tempera-

ture employed. Again, although their knowledge of the spectra of the stars was lamentably incomplete, he gathered the following facts from the work already accomplished with marvellous skill and industry by Secchi, of Rome:—First, the sun, so far as its spectrum went, might be arranged between stars with much simpler and with much more complex spectra. Second, Sirius, as a type of the former, was the brightest and therefore probably the hottest star in our northern sky; was only known to contain hydrogen, sodium, and magnesium; and the hydrogen lines in this star were enormously distended, showing that the chromosphere was largely composed of that element. There were many other bright stars of this class. Third, as types of the much more complex spectra, the red stars might be quoted, the spectra of which were composed of channelled spaces and bands. Hence these stars were of a lower temperature than our sun, and here the quantity of hydrogen was greatly reduced. He had asked himself whether these facts could not be grouped together in a working hypothesis, which assumed that in the sun and stars were various degrees of "celestial dissociation" at work, which prevented the coming together of the atoms which, at the temperature of the earth, and at all artificial temperatures yet attained here, formed the metals, all the metalloids not represented in each star, and the compounds known here at present.

In answer to Professor JANSEN,

Mr. LOCKYER said he thought it was extremely improbable that there should be any vapours which never came into the reversing layer; but of course, if this dissociation had any truth in it, there must be gold still in some part of the sun's atmosphere; but he asked whether it would not be at the extreme part of the corona rather than in the parts of the photosphere which were below the chromosphere. He had not said that gold was absent from the reversing layer of the sun, but that it had not been found there. The more the vapour occupied the lower part of the chromosphere the more conveniently would it give its spectrum; and recent researches had shown that the densities of substances which ordinarily occupied the lowest part of the reversing layer had little to do with the quantities there present.

Dr. GLADSTONE observed that a question of a very striking character had been raised; but it required thinking about for a little while before they could fairly grapple with it. It pointed to a revolution of their elementary idea in chemistry. He thought, however, that there was no impossibility whatever in what Mr. Lockyer had advanced. They knew that what they considered to be elements now were only elements to them. They did not know how to decompose them; but he imagined that there was no chemist whatever who imagined that they would never be able to decompose them. No chemist looked into the atomic weights and saw the curious relations between them without being convinced that there was some mystery behind them which would be revealed in the future. These were facts which were very suggestive indeed. If they greatly increased their power of heat and the other forces they could bring to bear on matter, they had greater power of tearing asunder those things which at the present time were elementary. The remark that there were no compounds in the reversing layer of the sun was very suggestive; and that would lead them to think that the dissociation had begun as far as our present metals, and that it was very possible that in Sirius and in some other stars it might go still further. He imagined, with M. Janssen, that there were various metals which were so very indisposed to rise into vapour that they would not come into that condition.

Professor B. STEWART thought Mr. Lockyer had acted very properly in throwing out the suggestion he had laid before the section. There had been too great a tendency in men of science to hoard up their ideas till they were almost certain in their own minds that their ideas were correct. He observed that he had found that iodine had a different spectrum for different temperatures; and he

wanted to know whether this was due to mere molecular change in the iodine, or whether it was decomposed.

Dr. HUGGINS remarked that the chief character of the lines of Sirius was that they were much thinner and finer than in the other stars. The spectrum of Sirius was as full of fine lines as the solar spectrum. The subject was a vast one, and they must wait for further information upon it before they could speak decidedly upon those points to which Mr. Lockyer had so properly called attention. He wished success to all who were engaged in this field of inquiry.

Dr. DEWAR dwelt upon the temperature of the sun and the electric light, and said that in order to settle this point they must take into consideration the total radiation of the sun. During the winter he had made experiments on the vapour densities of the alkaline metals, potassium and sodium. He found that in the case of the former the vapour density was normal; whilst in the case of sodium it was abnormal, being very much higher than it ought to be. This, he thought, accounted for the large amount of light and the enormous absorptive power of sodium vapour. The denser the vapour the greater was the amount of light got in the same temperature.

Dr. SIEMENS expressed the opinion that it was impossible to estimate the temperature of the sun by the amount of heat radiated from the sun; and said that Mr. Dewar, in making the comparison he had referred to, had compared two things which had utterly different conditions. In order to determine the temperature of the sun, they had only, as a safe guide, dissociation to go by. He thought Mr. Lockyer had opened out a new field of inquiry which might lead to important results.

Mr. LOCKYER, in his reply, said he took it that they had undoubted proofs that there were stars with compounds in their atmospheres, and that there were stars with metalloids in their atmospheres, and that the temperature of those stars was not so high as that of the sun. What had been a great difficulty to him had been to discover evidence of magnesium and sodium before evidence with regard to the formation of other metals; but with respect to that point Mr. Huggins had corrected Father Secchi in a very important matter. With regard to the observations of the Egyptians, they had always been made when Sirius was just on the horizon, and the gases in our atmosphere then cut off all the blue light. Hence Sirius had been regarded as a red star.

ON THE ENERGIES OF THE IMPONDERABLES, WITH ESPECIAL REFERENCE TO THE MEASUREMENT AND UTILISATION OF THEM.*

By the Rev. ARTHUR RIGG, M.A.

(Continued from page 155).

To progress from simple to compound is a most satisfactory procedure. Adopting this plan, and dealing with only two of the thirteen elements—ignoring the others—placing the two in such a relation that their mutual affinities may be fully exercised, the law as regards these two, and (as we shall see afterwards) the energy consequent upon this law, may be made fairly evident, and utilised in manufacturing industries as well as calculated with mathematical precision.

Let two be taken—any two—say, the gases oxygen and hydrogen. Place what we may call equal quantities of each apart from all other elements. Cause them to combine. It would be soon observed—i.e., if the experiment were repeated frequently—that this combination is not arbitrary, it is not at the experimenter's option. Although he may put different quantities of these gases in juxtaposition, yet by some means, and, for some reasons unknown to us, they unite only in definite proportions. If more than 11 ozs. of hydrogen be offered to 88 ozs. of

* The Cantor Lectures, delivered before the Society of Arts.

oxygen, the excess of hydrogen will be left uncombined, also the reverse.

As a case of estimation by measure, the nature of the affinities, their intensity, and the inexplicable results produce a comparison which is very striking: *e.g.*, 24 parts by measure of common salt contain 25.8 parts of sodium and 30 parts of liquid chlorine. Such condensation—that is, the condensing, into (say) 24 cubic inches of solid matter, so much as nearly 56 cubic inches—would require the exertion of a very great mechanical force. To appreciate this, it must be remembered that the salt, the sodium, and the chlorine are all under the same atmospheric pressure, and consequently, were there not certain inter-relationships among their constituent elements, of which we know nothing, such change of volume could not be accomplished.

The exercise of affinity, although definite as regards the proportions of the bodies influenced by it, is not called into action without either previous certain surroundings or the creation of influencing surroundings, such, for instance, as the presence of moisture or heat, or light or electricity. If, for example, we take these two white powders which are here mixed together, and add a little water to them, their affinities begin to operate, and a violent effervescence takes place. Again, the states of solid, liquid, and gaseous vanish under the energies of affinity. Mr. Wills will mix two gases, and they immediately form a solid. Now we will put two liquids together, and we find that they become converted into solids. In another case you see that the contact of two bodies suffices to change their state. If a little iodine is put upon this plate, and then a little phosphorus is added, the affinities are manifested by ignition, and the solids pass into the gaseous state. Nor are changes of state and temperature the only attendant phenomena of the energy of affinity; electrical phenomena are often, if not always, present, although not always observed.

It is not improbable that, if the energy of affinity is ever measured and brought within our means of calculation, it may be done inferentially, through some of these collateral manifestations which have not yet been so carefully observed, employed, and tabulated, as their importance would seem to justify. What it is that influences these affinities is as far beyond our present knowledge as to tell what it is that influences many of the affinities of social life amongst the thirteen children. The chemist not only endeavours to establish new relationships, but also to disentangle the relationships which affinities have already established. He fails to-day, he succeeds to-morrow. With bodies thus by the energy of affinity compounded and interlaced—

—In mazes intricate,
Recentric, interwolved, yet regular
Then most, when most irregular they seem."

—we all are concerned. Although we know not their laws, we do know that they partake of the Medo-Persian character—they change not—and, therefore, if once discovered, they are to be relied upon under all circumstances.

This Medo-Persian character of the laws which govern the energies of the affinities introduces into any calculation of them, when and where they are known, a precision and means of repetition, which give thus far to physical chemistry the character of an exact science. With a precision equal to that of the laws of gravity, it is found that in respect to combining proportions there is a mathematical order, perfect and exact. True, articles may be mechanically mixed in any proportions; they can be chemically combined only in definite proportions, and it is only when thus combining, in the chemist's sense of the word, that the "principle of least action" is brought into operation in affinity, and its results as economically utilised by men as the results of the energies of gravity and vitality were described to be in the last two lectures.

In mixtures the particles are still separate, and in many cases may be distinguished under a microscope. Here is

an instance. If this bottle is opened, the character of the whole contents is changed. The mixture of the atoms of the air with the nitrogen gas changed the appearance of the mass instantaneously. Again, you are all aware that coal gas burns in air, but we can also make the air itself appear to burn. In the presence of such experiments, it might become a question whether we burn gas in air, or whether we burn air in gas. Here is a cork through which are passed two small glass tubes. One of these tubes is connected with the gas of the room by this flexible india-rubber pipe, the other is open to the air. Now, light the gas issuing from the small tube. Here is a glass chimney, similar to those used with paraffin lamps. The cork has been fitted into the chimney. Place the chimney on the cork, the jet of gas burns as before. Let the supply of gas be increased, the consequence is that the chimney is soon filled with an atmosphere of coal gas; and observe, when a certain quantity of gas has entered, the flame quits the glass tube and now appears upon the air tube. Apparently air is now burning with a pale blue flame in an atmosphere of gas, whilst the gas issuing from the top of the chimney may also be ignited, and will burn in the air of the room. At the top, then, there is coal gas burning in air; and within, air is apparently burning in coal gas.

Again, for example, if gunpowder be taken and well washed, the nitre may be dissolved in hot water, and if the water be evaporated the nitre will be found as ordinary crystals; further, if heat be applied, the sulphur may be sublimed, and then pure charcoal will be left, or the sulphur may be dissolved out by bisulphide of carbon. Thus we can get the three elements of gunpowder, and find they are what they were at first. On another process of manufacture, if the nitre be fused in a crucible, and sulphur added, there results an entirely new substance—sulphate of potash; if to the heated mass charcoal be added, there is formed carbonic acid, and this, with the potash, forms carbonate of potash. No washing or warming will separate these latter combinations. They are for all purposes entirely new substances; they are no longer a mixture, as gunpowder is, in which the affinities may by a spark be called into play, but they are in a combination in which the affinities have already done their work, and that under the influence of continuous heat and without explosive violence, and, therefore, no further development of affinities, either with or without the energy of explosion, can take place.

The utilisation of gunpowder, then, is the result of a process of mixing, such mixing being designed to facilitate the action of several affinities, by placing the elements of the composition in close approximation, ready at a signal from a controlling agent to operate. It seems reasonable to say that the closer these elements are to each other the greater will be the facility with which combinations may take place, and, therefore, the more readily can the affinities be utilised. Such *a priori* reasoning is not confirmed; no simple mixture of impalpable powder, however intimately the dusty particles may have been mingled, fulfils the condition required in gunpowder. It is possible, however, so to diffuse such impalpable powder in the air of a room as that each minute portion is surrounded with an atmosphere of oxygen. If when thus diffused explosion by detonation of any group of particles takes place, the entire mass may explode. In mills for the grinding of madder this accident has happened so frequently as to require special precautions. Herein is an example of many cases in which, whilst admitting our thorough knowledge of the premises on which our reasonings are based, we are found at fault when we apply the knowledge; consequent, apparently, upon ignorance of certain even unsuggested peculiarities in the affinities involved.

Some of you may remember that in July last there was a very serious accident in a flour-mill at Glasgow. Property was destroyed to the value of £18,000 or £19,000, and nineteen lives were lost. But how it happened, or

why it happened, no one knew. The fire insurance companies deputed two scientific gentlemen to investigate the matter thoroughly, and they came to the conclusion, rightly or wrongly, that flour diffused through the air in the mill had become so uniformly or minutely mingled with the oxygen of the air, that the atmospheric contents of the room or rooms were in a state of what may be called gaseous gunpowder. The effect of a spark from the millstones or the machinery caused explosion of the aerial gunpowder by that most violent of all means—detonation. Such a conclusion of such a probable danger being only now surmised, shows how little we know of the energy of affinity. In this mill appears to be an example of the production of explosion from hitherto unsuspected sources.

We have in this bottle a diffused substance, and it is diffused in a liquid which rapidly evaporates. A piece of paper is immersed in the liquid, and we will now allow the paper to dry. When that is nearly accomplished the combustion of the paper with flame occurs, owing to the non-vaporisable solid being so minutely subdivided that the oxygen of the air is in contact with many atoms of the same material, and so energetically unites with them as to produce flame.

To apply the information already communicated to gunpowder may perhaps make as clear the influence which a more detailed knowledge of affinities would give than any other instance. The action of gunpowder is simply this: in a condensed material are many gases, we will speak of these gases as one—a gas. The utilisation of gunpowder might at first sight appear to depend upon having the largest amount of gas in the smallest solid space.

Now, without entering upon any chemical question, it may suffice to say that, in this mixture of nitre, sulphur, and carbon, are all the elements for (what we may name) the completion of the energies, though every other substance were excluded. We have here a jar of water, and if into that we put a mixture of gunpowder which has been ignited, you will find that water has no power to put an end to the combustion; it takes place as well under water as in air. From such reasoning and experiments as these, it might be anticipated that the cubic inch of gunpowder which on ignition produced the greatest number of cubic inches of gas would be the most valued. This so apparently satisfactory conclusion is very seriously in error. The amount of heat developed, and the rapidity with which the gas is formed, are important elements in guiding us to the mode of utilising the affinities called forth amongst nitre, sulphur, and charcoal. If the affinities are so intense that the development of all the heat and gas consequent upon the exercise of the affinities through the entire heap is instantaneous, then explosion of a very violent and destructive character takes place. Such an explosion for mining, and doubtless other, purposes, would entail serious loss—the rock, or the shell, would be so shivered as to be simple dust; our coals would have to be as artificial fuel, for the powder produced must, by tar, rosin, or other ingredient, be formed into lumps. To loosen and disintegrate, but not to destroy, are the general requirements for blasting or mining. If the rate at which the affinities in the mass are permitted to come into play can be regulated, and so either retarded or accelerated, then the modes of utilising them may be planned. For example, if a ball is to be sent from a gun, that law should, if possible, be impressed upon the affinities which Nature has impressed upon the energy of animal vitality. A horse accomplishes the dragging of a load by slow beginnings, a locomotive does the same, affinities must do the same. Hence, the development of the greatest intensity of affinity in the case of a gun should be progressive until it attains a maximum, and the time occupied in so doing should be determined by the rate of travel of the ball and the strength and length of the gun.

Other cases, such as the blasting of rocks, demand a very different exercise of affinities. Here the object is

simply to disturb, to unsettle, to break up; motion of the pieces to a distance is not required. Considerations such as these, simple as they may appear, are full of perplexity, consequent upon our ignorance of that in which these affinities consist.

Similar remarks apply to gun-cotton, dynamite, nitro-glycerine, litho-fracture, or any of the explosives which modern science has formed.

It is from an attempt to impress upon the affinities a law of time in their exercise that the various forms and compositions of gunpowder owe their origin.

We are much obliged to Mr. Abel, who has kindly lent the Society of Arts different samples of gunpowder. There is one bottle containing powder the grains of which are nearly half an inch cube; there are various other forms, the object of these various forms being to develop the affinities at a rate to be determined by the purpose for which the respective gunpowders are to be employed.

The pressure at the time of explosion has been estimated at more than 4000 atmospheres, i.e., more than 4000×15 lbs., or 60,000 lbs. per square inch. This statical pressure, being converted into a kinetic or velocity estimate, is more than 216 tons lifted 1 foot.

(To be continued.)

CORRESPONDENCE.

THE ENDOWMENT OF RESEARCH.

To the Editor of the Chemical News.

SIR,—I have just read your remarks on the above subject contained in the leading article of the *CHEMICAL NEWS* of Sept. 12, and with many others share the apprehension there expressed. Without claiming any degree of unnatural purity for the votaries of science, we may venture to affirm that *hitherto* no class of men have been more free from jobbery than scientific investigators. I suspect that this is owing, in a great measure, to the fact that "research is unremunerative," and therefore has no attractions for the jobbing classes, or for those who are unable to work hard and live frugally. The man who thinks it essential to his dignity and happiness to have "an establishment," and to join the race and rivalry of modern sensual expenditure, is not likely to devote himself to pure science, and science can do well enough without him.

If we are to have *prospective* payment for scientific research in the shape of fellowships, &c., we may be almost certain that dodgers, jobbers, fawners, and sneakers of all sorts will be attracted thereby, and the distribution of the scientific endowments will become as corrupt and disgraceful as the sinecures attached to our ancient cathedrals. Let us rather fall into abject poverty than sink so low as this!

At the same time, it is unquestionably true that, as science advances and the simple problems become already solved, the cost of apparatus and sacrifice of time demanded by the more recondite objects of scientific research continually increase, and place such investigations quite beyond the reach of men who have to earn their daily bread by daily teaching. As these constitute the bulk of qualified scientific workers, the pecuniary difficulty is practically the chief existing impediment to the progress of science, and consequently of civilisation. How, then, may such men be aided without being corrupted, and without a bait being held out for the enticement of "scientific Micawbers"?

I think this question may be answered at once. Let us have a fairly liberal endowment of scientific research based upon the principle of *payment for results*. This is the sound and natural principle which, by natural selection, has come into operation for the general remuneration of useful human efforts. Other men are paid for work done; why, then, should scientific workers be remunerated

otherwise? Let us suppose a case; or, to put it more pointedly and practically, I will take an actual case on which I can speak definitely. I have made and published certain preliminary investigations "On the Diathermancy and Transparency of Flame and their Consequences." These open out an extensive field of further research, which I am prevented from exploring by stronger claims than those of science, viz., duty to my own family. I cannot afford to expend £40 or £50 on apparatus, and devote £100 or £200 worth of time to unremunerative research; but if there were a market for the results of such scientific research only equal to the market which I can find for scientific teaching and scientific literature, then I might devote some of my small capital to the apparatus of research, just as I do to the purchase of diagrams and lecture apparatus, and I could also afford to give my labour in advance, just as I now do in delivering a course of school lectures payable at the close of the school term. Every other reasonable man who desires no sinecure and seeks no more than the modest income of a teacher would gladly do the same, and willingly incur all reasonable risk of failure, provided his work, when done, were fairly valued by a competent and impartial tribunal.

I have thus illustrated my argument by my own case simply because it is a truly typical one representing the actual position of the great majority of qualified scientific workmen.

If a fund for such payment of scientific research existed, the genuine worker might send in his bill with the paper communicating the results of his researches, and such a bill, after being fairly taxed, should be paid, like any other honest account, in a simple and business-like manner. The man who makes a pair of shoes supplies the want of a single individual, and is paid accordingly by the recipient of the benefit. The toiler in the workshop of science who reveals a new truth is a benefactor to the whole of mankind, has a fair and honest claim against the whole human race, and is entitled to draw a bill accordingly, which should be accepted and honoured by his own country at least. Decent gratitude and common honesty demand so much from the nation. It should be done, and may be done, without opening a door to jobbery or any multiplication of corrupt and idle pensioners.

It is just possible that a few superior gentlemen may be shocked at such commercial treatment of science, but some considerable experience among men of all sorts has taught me that these superior creatures who affect a contempt for trade and traders are, with very few exceptions, a set of lazy humbugs, who are distinguished from honourable men of business by their unscrupulous readiness to obtain money by any means rather than honestly earning it. I therefore dismiss their objections without further notice.

Those who have the advantage of leisure and independent means may, of course, still enjoy the honourable privilege of nobly devoting themselves to the highest of human pursuits, and freely presenting their fellow creatures with the results of their industry. The more fully and publicly are the claims of science recognised, the greater will be the number of such distinguished men.

Who, then, should pay the wages of the scientific workman? The nation, undoubtedly; but before we can expect this to be initiated by Government, we must be represented and ruled by men who have sufficient scientific knowledge to be able to appreciate the importance and the claims of science. In the present state of our Universities the prospect of this is somewhat remote. In the meantime we have more to hope from private action than from Government help. In a nation where there is so much public spirit that millions are expended in "improving the breed of horses," in spite of the turf abominations with which this effort is associated, where noblemen and other millionaires can be found who will devote tens of thousands in a single season to support an opera house or a theatrical leg-show, there surely need be no difficulty in raising a sufficient fund for supplying

the immediate wants of scientific progress. I say the immediate wants, believing that it would be very demoralising to the nation if the performance of a primary national duty were permanently left to private generosity. If, however, the work were started by private effort, if its efficacy and the possibility of carrying it out without jobbery were proved, then any intelligent Minister of State might take it up, and enable the whole nation to deal justly and honourably with the most useful of its servants, instead of meanly appropriating their unrequited services, as the mighty empire of Great Britain is now so disgracefully doing.

W. MATTIEU WILLIAMS.

Woodside Green, Croydon,
Sept. 15, 1873.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopaedic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, September 1, 1873.

On Auroræ Boreales, apropos of a Recent Memoir by M. Donati.—M. Faye.—Donati seeks the explanation of auroræ in a meteorology which he terms cosmic. The phenomena are probably due to electro-magnetic currents going from the sun to the planets, their vehicle being the ether. M. Faye, hesitating to accept this view, directs attention to the forces really acting in interplanetary space. In addition to attraction there is the force producing the phenomena of comets. Might not this, operating on our earth, give rise to auroras? The effects of this repulsive force are proportioned by surfaces and not by masses. Insensible in very dense bodies, they become enormous in matter of extreme tenuity. Hence the immense comets' tails of 30, 40, and 60 millions of leagues having a direction away from the sun. These rarefied matters have a very high velocity, as if solicited by a force twelve or fifteen times greater than that of gravity. Spectral analysis shows that comets have two kinds of light; one from solar illumination, the other proper to them, and characterised by bright lines of a discontinuous spectrum, indicating incandescence of gaseous parts. The earth, too, viewed from afar would present two spectra; that of solar light, and in the obscure part near the poles the discontinuous spectrum of its auroras, boreal and austral. The author does not think the feeble incandescence of cometary matter is caused by solar heat, for the same rays do not produce such effects with us. If a screen were placed across the tail, the particles striking it would likely become suddenly incandescent. Now the nucleus is just such a screen; against which the anterior molecules of the nebulosity strike, producing heat and light; while, on the other hand, molecules not thus arrested pass rapidly behind and from the tail. Thus there is a double effect. On our globe only the extreme and very rare layers of atmosphere have some analogy to these cosmic nebulosities, but they may give rise to some of these phenomena; not tails indeed, for the greater attraction of the globe holds in the matter about it. But they might produce some feeble light-effects similar to those of comets if the repulsive force communicated to them in certain regions a considerable velocity, transferring them to other regions of our globe. The limits of our atmosphere are unknown, but the true limit will be where our

air, having become more rare than the vacuum in our best pneumatic machines, has been reduced to a medium doubtless comparable in density to the cometary nebulosities, on which the repulsive force of the sun acts. Consider this limit; it is not likely spherical. The lower layers of our atmosphere show by the barometer a well-marked minimum of pressure at the poles, and maxima which do not coincide with the equator. Temperature and radiations produce great irregularities in them; and it must be the same with the extreme layers. They probably experience on the side next the sun, the side on which they attain highest elevation, a repulsive force appearing in a slight pressure centrally, and movement at the edges. This limiting layer is thus conceived as having a less curvature, though a higher elevation, than that of the opposite side; and, as in the inferior layers (though in greater degree), presenting a depression near each pole on the right side, where the ground and inferior layers radiate least to the heavens. Then as to the edges of the hemisphere turned towards the sun. The superficial parts, reduced to extreme rarity, obey the repulsive force and are driven tangentially, acquiring considerable velocity in an hour or two. Reaching the depression near the poles they enter the vacuum and rush across it. The earth's attraction produces a strong curvature in their trajectories, and they meet the limiting surface of the atmosphere beyond the depression; and if their velocity may have reached several hundred metres per second, the incessant shock of these mobile particles against the fixed will give rise to light. The slight illumination which will be visible to us in a limited part of the heavens will have the characters of gaseous incandescence. This phenomenon will not occur equally all round the globe. In regions a little removed from the poles there is no vast depression to cross; the molecules in their passage encounter the resistance of a continuous layer, and cannot acquire the same velocity as at the poles. Hence the light will mostly be produced at the poles, and especially at the pole actually deprived of solar light. The author's purpose is not to assert this as the veritable cause of polar auroras, but to show that, apart from the mysterious causes one is tempted to invoke, there is besides Newtonian attraction a real cosmic force which must play some part in our meteorology, and which is connected very simply with the sun itself, and especially with the variable state of his surface.

Note on Siemens's Bobbin.—M. Pellerin.—The chief disadvantage of it is that it develops a considerable amount of heat, and thus work is lost. The heat probably arises in most part, from currents developed by the movement in the metallic mass forming the core. Such currents, which are parallel to the axis of rotation, may be obviated by forming the core of discs of soft insulated iron, the combination of which in a sufficiently solid manner is not an insurmountable difficulty.

Changes of Form and the Spectrum of the Comet (1873) IV.—MM. Rayet and André.—On the 26th and 27th August the comet had a circular form of about 6 min. diameter, with luminous condensation in the centre. Its spectrum consisted of three bright lines in green, yellow, and blue, the first being longer than the two others. On the 29th and 30th its diameter was 8 min., and it showed a tail of 25 min. directed away from the sun, and inclined at about 47° to the direction of diurnal motion. The head, still round and with a brighter nucleus, gave a spectrum of three luminous bands as before, but also a faint continuous spectrum. Some peculiarities in the green band are noted. Drawings of the comet are given.

Form of Martial Seas Compared with that of Terrestrial Oceans.—M. Meunier.—According to one theory of sidereal evolution Mars is an older planet than our earth, and now presents features which our earth should present later. The author finds a new indication of the greater age of Mars in the form of the oceans on the planet, which are described by Mr. Proctor as of

bottle-necked shape—long and narrow passages. Now if one takes a marine map, such as that of the North Atlantic Ocean, and traces successive horizontal curves for increasing depths, one perceives that these curves tend progressively to limit zones, the form of which is more and more elongated. At 4000 metres, for example, one obtains forms comparable in all points to those of the Martial seas described. Hence, if we suppose the Atlantic absorbed by deep masses actually in course of solidification, so that the surface of this ocean sinks to 4000 metres, we should have a small surface covered with water, and a narrow elongated form of sea exactly as in Mars.

Metalliferous Veins of Cornwall; the Rich Portions of the Veins, the Structure of Such Portions, and their Relation with the Direction of the Stratigraphic Systems.—M. Moissenet.—The author draws the following conclusions:—The parts of the vein whose incline approaches most nearly to a vertical direction are the most productive. The rich portions are commonly, in Cornwall, enclosed in a gangue of moderate hardness. Most frequently the metalliferous bands or columns incline in the same direction as the gangue. The rich portions are frequently disposed according to the direction of the stratigraphic system to which the initial fracture of the vein is related.

Gazzetta Chimica Italiana, Anno III.,
Fascicolo VII. e VIII., 1873,

Researches on the Nature and Constitution of Tannic Acid.—Ugo Schiff.—The author reviews the previous labours of Berzelius, Strecker, Robiquet, Rochleder, Hlasiwetz, Löwe, &c. He then examines the reactions of tannic acid with the oxychloride of phosphorus and with arsenic acid. The composition of aceto-tannic acid he gives as—

Carbon	54.2
Hydrogen	4.4
Acetyl	41.5

corresponding to the formula $C_{21}H_5(C_2H_3O)_2O_2$. He concludes his interesting paper with an examination of the ellagic and rufallic acids.

Butyric Acid Generated in Fermentation.—G. B. Grillone.—The author made an extract 5 kilos. of rice in 60 litres of boiling water. After twenty-four hours 60 grms. of malt were added, steeped in 2 litres of milk, 1 kilo. of minced flesh, and 2 kilos. of white chalk. The whole was allowed to ferment in a covered wooden vessel at the summer temperature (25° to 30°). When the development of gas had ceased the liquid was raised to 80°, filtered, mixed with carbonate of soda as long as a precipitate was produced, the carbonate of lime filtered off, and the filtrate concentrated to a small volume and mixed with sulphuric acid, when a considerable quantity of crude butyric acid separated, and was freed from accompanying products by fractional distillation.

Action of Aldehyds on the Bisulphite of Naphthylamin.—Dr. G. Papasogli.—Benzoic aldehyd was added to a hot aqueous solution of bisulphite of naphthylamin. The liquid became turbid, and small white crystals were deposited, soluble in alcohol, but insoluble in ether and water. They contain—

Carbon	61.63
Hydrogen	5.13
Sulphur	9.66
Nitrogen	4.27
Oxygen	19.33

corresponding to the formula $C_{10}H_9N_2H_2SO_3 \cdot C_6H_5O$. This benzoyl-bisulphite of naphthylamin loses all its sulphurous acid at a gentle heat, yielding a fusible resinous compound very soluble in ether, moderately soluble in

absolute alcohol, but insoluble in water. The ethereal solution on treatment with ordinary alcohol deposits a whitish yellow crystalline powder containing—

Carbon	88.32
Hydrogen	5.62
Nitrogen	6.06

100.00

corresponding to the formula $C_{10}H_7N_2O_6$.

Action of Amides on Phenol.—Dr. Icilio Guareschi.—The author has studied the behaviour of benzamid and acetamid on phenol, and that of benzamid on the salicylate of methyl.

Action of Chloroform on Phenate of Potassa.—Dr. J. Guareschi.—The author, wishing to find a sensitive reaction for detecting the presence of phenol evaporated to dryness, a solution of phenol to which potassa had been added, and the residue while still warm was mixed with chloroform; a splendid purple-red colour was immediately developed. The potassa must not be in excess, nor the temperature very high. The reaction is decisive with 0.1 milligram of phenol. The colour is probably due to the formation of rosolic acid.

Synthesis of Conina.—Ugo Schiff.—This paper is taken from the *Annalen der Chemie und Pharmacie*, vol. clxvi., p. 83, with some additions by the author.

Analysis of a Sulphurous Water from Messina.—G. Mazzara.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, par Ch. Mène, No. 33, 1873.

The only chemical paper in this number is the description of an apparatus for the analysis of gases, patented by M. H. Orsat. A description would be unintelligible without its accompanying woodcut.

Reimann's Färber Zeitung, No. 32, 1873.

In the continued notice of the Vienna Exhibition we find mention of Scheuermann's birling-inks, as distinguished for excellence in quality. We find receipts for dyeing and finishing plushes; for a bright green on wollen piece-goods, flannel, and wool; a medium green on wollen cloth; a dark green for shot-goods; a silver grey, a drab, and a bright salmon on cotton yarn; a green on wool and wollen yarn with Nicholson's blue. This may be produced by boiling the 100 lbs. of goods, previously dyed a medium blue with 1½ lbs. sulphuric acid, 3 lbs. alum, and about 1 lb. picric acid till the required shade is obtained. A faster green can be obtained by boiling the same weight for an hour with 3 lbs. alum, 2 lbs. tartar, and 12 lbs. fustic, or young fustic. The latter gives a brighter, but the former a faster shade. There are also receipts for an olive on wool, a dark blue and a bright brown on wollen piece-goods. In the garment, or old materials department, are receipts for a panny on silk, and a brown on mixed silk, such as silk and satin ribbons.

The following formula is proposed for a chrome yellow on calico:—The pieces are saturated with a solution of sugar of lead (1½ lbs. per gallon), dried, printed with a colour composed of alizarin, red liquor, and acetic acid thickened with starch, steamed for ninety minutes, aged for two days, passed through a solution of 3 ozs. chromate of potash per gallon, handled in a weaker solution of the same salt, washed and brightened with soap. "Anthracene blue" is still flourishing, at least on paper. According to the inventor 25,000 grs. of anthracene yield only 2½ grs. of this mysterious colour, whence Dr. Reimann calculates its cost at 20,000 six-dollars (£3,000) per lb. The inventor of this same colour gives the following receipt for a black on linen yarns. "To 100 lbs take 4 lbs. catechu, 4 ozs. sulphate of copper, and 1½ lb. potash, and give it a couple of turns at a brisk heat. It is then worked for half-an-hour in a boiling bath of 5 to 6 lbs. of logwood, and 1½ lbs. of

sumac, blackened in the same flat with 1½ lbs. copperas, rinsed, finished with starch and tallow or lard (!), dried, and well calendered."

MISCELLANEOUS.

Assay of Crude Phenic Acid.—Hager gives the following process for the assay of crude phenic acid:—5 c.c. of the sample are taken and shaken up with 3 c.c. of a mixture of caustic potash (sp. gr. 1.34) and of alcohol at 95°. (The respective quantities of potash-lye and of alcohol are not stated.) 5 c.c. of essence of petroleum are then added, and the whole shaken again. It is then allowed to settle. When the liquids have separated the volume of the lower stratum is read off. The increase in its bulk shows the amount of actual phenic acid present in 5 c.c. of the sample. The lower stratum consisting originally of the alcoholic potash liquor its bulk was 3 c.c., and all increase is due to the quantity of phenic acid. Schœdler proposes a method of assay based upon the fact that phenic acid when heated combines with sulphuric acid, whilst the latter carbonises the tarry products, disengaging a certain quantity of sulphurous acid. If we add to the products of this reaction of sulphuric acid with crude phenic acid water, and then carbonate of baryta or litharge, there is formed a soluble sulpho-phenate and an insoluble sulphate, which carries down with it the carbonaceous matters, whilst the oily substances separate themselves in virtue of their insolubility. All that is then needful is to precipitate the solution of sulpho-phenate of baryta with sulphuric acid, and to deduce the quantity of phenic acid from the amount of sulphate of baryta obtained. The following are the details of the process:—2 to 3 grms. of the sample in question are taken and heated in the water-bath to volatilise any alcohol that may be present. An equal quantity of concentrated sulphuric acid is then cautiously added, and the mixture is then exposed to a temperature of 50° to 60°. The liquid is then diluted, mixed with carbonate of baryta or litharge in excess, and filtered by decantation. The filtrate presents a yellowish colour. It is decomposed by dilute sulphuric acid; the precipitated sulphate of baryta or of lead is collected and weighed, and the amount of phenic acid is calculated.—*Moniteur Scientifique*.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in purifying sewage and treating products obtained therefrom for the production of manure. Baldwin Latham, 7, Westminster Chambers, Victoria Street, Westminster, Middlesex. January 28, 1873.—No. 331. This invention consists in utilising the precipitate obtained from sewage in the "alumina," phosphate of alumina, and other phosphatic processes, and the "magnesia" and "iron" processes for treating other sewage for the production of manure. The said precipitate is first dried, and after standing some time is treated with sulphuric or other acid, so as to convert the alumina in sulphate and sesquisulphate of alumina and the phosphates of alumina and lime into superphosphates, and also to carbonise some of the organic matter. The compound so treated is then mixed with the sewage, together with sufficient alkali to neutralise the acid, whereupon the resulting alumina, phosphate of alumina, and phosphate of lime, are precipitated, and, at the same time, the flocculent deposit formed drags down the suspended matters in the sewage, while the humus, mould, and carbonised matter of the compound combine with some of the ammonia. The deposit thus obtained may be used as a manure, or it may be dried and treated and be again applied to other sewage, in the above-described manner, in order to obtain a rich manure. The solid matter may be first removed from the sewage by the apparatus described in the petitioner's specification, No. 809, of 1869.

Improvements in the means employed for freeing glass from carbon, grease, or other substances that may adhere to its surface. James Augustine Hartley Toulson, manufacturing chemist, and Thomas Harmer, Leeds. January 28, 1873.—No. 335. Fluoric acid in combination with muriatic or nitric acid, and sometimes other acids; or fluoric acid with water; sometimes a powder is used composed of pumice-stone, slaked lime, salts of tartar, Derbyshire spar, powdered soap, sugar. The invention is particularly applicable to railway-station or other large roofs.

Improvements in lamps and apparatus for burning mineral oils or other inflammable liquids. Joseph Sokolnicki, Clinchier, near Castillon, France. January 28, 1873.—No. 336. This invention consists in com-

hining with the burner of the various forms and arrangements of lamps an evaporating tub, for the purpose of keeping up the supply of vapour from the mineral oil, or essence or other inflammable liquids, and thereby prevent the light from becoming small or extinguished.

Improvements in lamps for burning heavy oils. John Henry Johnson, 47, Lincoln's Inn Fields, Middlesex. (A communication from Robert Hitchcock, John Morton Sigourney, and William Van Vranken Ross, all of Watertown, (Mass.) U.S.A., January 22, 1873.—No. 352.) This invention is directed to the burning of heavy oils in lamps in such manner that a brilliant flame without smoke may be produced without requiring the use of a chimney. To the accomplishment of this object I have found the following instrumentalities requisite:—First, passages or ducts through which air may be conducted both to the exterior and interior of the flame; secondly, mechanism for impelling currents of air through these passages to both the exterior and interior of the flame; thirdly, a deflecting cap or cone placed over the wick with an aperture for the passage of the flame, and so shaped as to direct an external impelled current of air to impinge upon the exterior of the flame.

An improved explosive powder or compound, and the mode of preparing the same. H. H. Murdoch, patent agent, 7, Staple Inn, Middlesex. (A communication from Baron Vidler de Kutenberg, Paris, January 30, 1873.—No. 356.) This invention consists in mixing randanite with nitro-glycerine in order to produce an improved explosive powder. Randanite, which is a hydrated silica, was first discovered at Randanite, in France. According to this invention the randanite is first dried and then roasted at a light red heat. It is then reduced to powder and sifted, and is ready for use as an absorbent for nitro-glycerine. Should, however, the randanite used be very impure, it should before being treated as described be washed in an acid solution. The improved explosive powder is made by mixing the prepared randanite with nitro-glycerine by pouring the nitro-glycerine gradually upon a quantity of the prepared randanite upon a surface coated with gutta-percha or soft metal, and stirring the mixture with a wooden spoon or stick. Or the mixing might be effected in a mixing machine.

Improvements in the manufacture of manures. John McDougall, of the firm of McDougall Brothers, manufacturing chemists, Manchester and London. February 1, 1873.—No. 353. This invention has for its object improvements in the manufacture of manures. I treat phosphatic substances with sulphuric acid to render them soluble and remove the soluble constituents (either whole or in part) by washing, filtration, or other convenient method, and into the resulting solution I pass liquids, gases, vapours containing ammonia, and the resulting product may be concentrated or dried by exposure or heat. Or, after passing ammonia into the resulting solution as herein described, I allow the precipitated phosphate of lime to subside and separate the liquid, which can be evaporated into a salt. The precipitated phosphate can be dried for use or incorporated in the semi-liquid state into the manufacture of superphosphates as hereafter described. The solution obtained as herein described may be used for the removal of ammonia in coal-gas or other gases arising from the destructive distillation of carbonaceous substances, by employing it in the ordinary washers or scrubbers in use in gas-works, or by other convenient method. I also treat phosphatic substances with hydrochloric acid in any desired quantity to render them soluble; if sufficient of the acid has been added to convert the phosphate into the liquid state, any insoluble residue may or may not be removed by subsidence or other convenient method; and into the mass or liquid I pass gases or vapours containing ammonia other than coal-gas. The resulting product can be concentrated by heat or exposure. Or, in treating the phosphatic substances with hydrochloric acid as above described, I take care the acid is of reduced strength, or, if acid of full strength is used, the resulting solution may be diluted, so that, after passing in the gases or vapours containing ammonia, the resulting solution shall not be too dense to allow the soluble phosphate that has become changed into precipitated phosphate to subside, so that the liquid may be run off and evaporated into a salt, and the precipitated phosphate dried for use. In the manufacture of superphosphate of lime, when sulphuric acid is used, it is customary to dilute the acid with water when bringing it into contact with the phosphate to be acted upon, by which means a drier product is obtained than if acid alone were employed. This water, either whole or in part, may be mixed with liquids or semi-liquids containing ammonia or other useful manurial ingredients, and so utilise them, at the same time obtaining a manure of sufficient dryness. If the liquid used requires the addition of an acid for its proper utilisation, the acid must be added to it before using, or extra acid added to the phosphate. After the removal of the soluble constituents from the phosphatic substances treated with sulphuric acid as already described, the residue will consist to a large extent of sulphate of lime, this sulphate of lime, or sulphate of lime obtained by other methods or in a natural state, or chloride of calcium, I treat with liquids or semi-liquids containing ammonia, and whilst agitated pass in carbonic acid, which causes the decomposition of the sulphates or chlorides, and liberates the acids to combine with the ammonia. After subsidence, I separate the resulting solution and evaporate it into a salt. The carbonic acid generated in the treatment with an acid of the phosphatic substances containing carbonic acid may be utilised for this purpose, or may be derived from other convenient source. When it is desirable to convert the precipitated phosphates obtained by the foregoing process again into soluble phosphates, either wholly or in part, I add sulphuric or any suitable acid to effect this purpose.

NOTES AND QUERIES.

Water Free from Ammonia.—Being in frequent use of Wanklyn and Chapman's "ammonia process" in water analysis, I have found the preparation of "ammonia-free" water, for comparison, to be a

tedious and troublesome operation, especially if required in large quantities; an accidental discovery has, however, relieved me from further inconvenience upon that score. I have in my laboratory a copper drying oven heated by steam from a boiler. The oven is secured against excessive radiation by an outer case of wood, but, notwithstanding this, there is a considerable amount of condensation goes on in the copper jacket of the oven, and I find that the resulting water is free from every trace of NH_3 ; thus I have a constant supply of water, which only requires cooling to render it fit for even the most delicate determinations. The high temperature at which the steam is condensed is evidently the cause of the purity of the water.—W. F. K. STOKES, F.C.S., Laboratory and Assay Office, Wooler Street, Darlington.

TO CORRESPONDENTS.

H. H.—"Joteline" is a peculiarly made aniline black. Methods for using it in photography have been described in photographic periodicals.

A. P.—The following is the prescription for hydrosulphate of soda, as given by Schützenberger and Kinsler:—Allow 30 grms. of bisulphite of soda at 30° Baumé to act on zinc turnings, air being excluded. After about half an hour, 50 to 100 grms. of milk of lime are added containing 200 grms. of quick-lime per litre. It is then diluted with 5 litres of water, shaken up, the clear liquid decanted, and preserved in small bottles completely full, well stoppered, and inverted under water.

J. Wilson.—As the wool has been already treated with sulphuric acid, it is not likely that any substance will, without either destroying the wool fibres, or altering it so as to render it worthless except as a manure, discharge the dark colour from the wool, which cannot be treated with chlorine or similar agents; still you might try the action of sulphurous acid gas, which might to some extent bleach the dark coloured wool, which appears, however, to have been dyed with fast colours.

THE QUARTERLY JOURNAL OF SCIENCE.

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THE CHEMICAL NEWS.

VOL. XXVIII. No. 724.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

BRADFORD MEETING, 1873.

SECTION B.—CHEMICAL SCIENCE.

PRESIDENT, DR. W. J. RUSSELL, F.R.S.

"The Purification and Utilisation of Sewage."—MR. R. B. GRANTHAM, C.E., brought up the Report of the Committee of the Association on the Treatment and Utilisation of Sewage. The meetings of the Committee had been attended by Mr. Grantham, Professor Corfield, Mr. J. H. Gilbert, Mr. W. Hope, and Professor A. W. Williamson. The Committee stated that it had continued that part of the inquiry for which it was particularly re-appointed last year, viz., the examination of the typical case of sewage farming at Breton's Farm, near Romford. Tables similar to those of last year were again supplied. An analysis had been made of the soil of the farm, showing a considerable increase in the amount of nitrogen and of phosphoric acid. A further examination had been made of the sewage farm at Earl's Wood, with more satisfactory results than before. Dr. Gilbert had again furnished a note on the dry earth system. Whitehead's process had been for a few days at work on a considerable scale at Enfield. The Local Government Board had obtained returns of loans for sewage farms, conducted by local authorities. The information in those returns would be valuable if exact. A radical defect in them was that there was no separation of capital from working expenses, and the cost of land was lumped with that of the works.

Mr. Hope read an elaborate report on Breton's farm at Romford. Systematic observations had been continued and summarised in tables corresponding to those of last year. Many of the results thus contrasted were instructive; but the tables, although themselves only summaries, were so voluminous that it was impossible adequately to describe them. The points of chief importance were that the effluent water was slightly purer, thus exploding the nonsense sometimes talked about land becoming "sick" of sewage, that an analysis of samples of the soil taken in April, 1873, at the same part of the farm as the samples were taken from for the analysis of 1870, prior to the application of any sewage, showed very appreciable quantities of phosphoric acid, ammonia, and nitric acid, when valuable manures were almost indeed practically absent in the same soil in 1870. The Committee also found that the population of Romford had been largely overestimated by the Local Board, and that instead of between 7000 and 8000 persons feeding the sewers there were only about 4600 persons in all. This, of course, gave a very different complexion to the agricultural results, and, amongst other things, gave the new and important fact, that in the case of the town the sewage of the population, including, of course, kitchen and wash-house slops, and that due to horses and to live-stock on market days, contained 13·14 lbs. of nitrogen per head per annum.

Professor CORFIELD gave the substance of an abstract of all the reports which had been presented to the Association by this Committee since its first appointment. The final opinions of the Committee were in substance as follows:—

I. All conservancy plans, including midden, heap, and cesspool systems, dry ash, and dry earth closets, pail closets, &c., are quite incompetent as solutions of the general question of the removal of the refuse matters of a population; they only deal with a small part of the liquid

manure; towns which resort to one of them require to be seweraged, and the sewage requires to be purified. The manure produced is in all cases (except in that of pimple pails or tubs, where no extraneous materials are added) poor, and will only bear the cost of carriage to a short distance, taking into consideration the cost of collection, that produced by the dry earth system being, even after the earth has been used three times over, merely a good garden mould. Moreover, these plans all violate one of the most important of sanitary laws, which is that all refuse matters which are liable to become injurious to health should be removed instantly and then be dealt with afterwards. With all these plans, it is an obvious advantage on the score of economy to keep the refuse about the premises as long as possible, and the use of deodorants of various sorts, or even of disinfectants, proves that this is the case, and that these systems all depend upon a fallacious principle. They should therefore be discouraged as much as possible, and only resorted to as temporary expedients, or with small populations, in very exceptional instances.

II. The water-carriage system, on the other hand, is based upon a sound principle, that of removing all the refuse matters at once and in the cheapest possible manner by gravitation, and ought to be resorted to in all but the most exceptional cases. The opinion of the committee that all sewers should be made of impervious materials, and that separate drains to dry the subsoil should be constructed where necessary, has already been most emphatically expressed. The freest possible ventilation of sewers, house drains, and soil-pipes, in order to prevent accumulations of foul air, is also essential. With regard to the utilisation of sewage, the Committee has come to the conclusion that the precipitation processes that it has examined are all incompetent, and necessarily so, to effect more than a separation of a small part of the valuable ingredients of sewage, and that only a partial purification is effected by them. Some of them may, however, be useful as methods of effecting a more rapid and complete separation of the sewage sludge.

The upward filtration process only effects a clarification of the sewage, and is, therefore, no solution of the question.

Weare's charcoal filtration process, as carried on at Stoke-upon-Trent Workhouse, did not give satisfactory results, the effluent water being in effect weak sewage; an opportunity will, however, soon be given for an examination of this process in a modified form on a much larger scale at Bradford, and under more favourable conditions. Intermittent downward filtration through soil has been shown at Merthyr Tydfil to afford a means of purifying the sewage under favourable conditions, but it cannot be said to be a method of utilisation except to a partial extent, as the investigations made by the Committee showed that the effluent water contained as much nitrogen as was originally in solution in the sewage, but mainly as nitric acid, instead of as ammonia and organic nitrogen; and there can be no doubt that the process will prove useful as an adjunct to irrigation, or where a sufficient amount of land for irrigation cannot conveniently be got.

By properly conducted sewage irrigation a solution is afforded to the question of sewage utilisation; it has already been stated that a precipitation process, or some clarifying process, may be found useful; in all instances it is essential that the land should be well underdrained, and that the sewage should all pass through the soil, and not merely over it; otherwise, as has been shown, it will only occasionally be satisfactorily purified. The catch-water, or, as the Committee has termed it, the "super-saturation" principle, is not defensible either on agricultural, chemical, or sanitary principles; an irrigation farm should therefore carry out intermittent downward filtration on a large scale, so that the sewage may be always thoroughly purified, while at the same time the maximum of utilisation is obtained.

It is certain that all kinds of crops may be grown with sewage, so that the farmer can grow such as he can best sell. Nevertheless, the staple crops must be cattle food, with occasional crops of corn; and it is also certain from the analysis of the soil that it has become very much richer, and that the manurial constituents of the sewage accumulate in it. Cattle should be fed on the farm, which leads to a vast increase in the production of meat and milk, the great desiderata of the population producing the sewage. Thus the system of farming must be specialised and capital concentrated, the absence of which conditions has proved a great barrier to the satisfactory practical solution of the sewage question.

The Committee has not been able to trace any ill effects to the health of the persons living around sewage farms, even when badly conducted; nor is there any proof whatever that vegetables grown thereon are in any way inferior to those grown with other manure. On the contrary, there is plenty of evidence that such vegetables are perfectly suited for the food of man and beast, and that the milk given by cows fed on sewage grass is perfectly wholesome; thus Mr. Dyke, Medical Officer of Health of Merthyr Tydfil, states that since the abundant supply of milk from the cows fed on irrigated grass the children's mortality has decreased from 48, 50, and 52 per cent of the total deaths, to only 39 per cent, and that so far from diarrhoea having been made more prevalent by the use of sewage cabbages, "last year the Registrar-General called attention to the fact that diarrhoea was less prevalent in Merthyr than in any place in England and Wales;" and he expressed his belief in "the perfect salubrity of the vegetable food so grown."

With regard to the assumption which has been made that enteric disease would be propagated by irrigation, all the evidence that the country has been able to collect, and more especially the positive facts obtained by experiments, are against such an idea, and the Committee is of opinion that such disease will certainly not be more readily propagated by sewage irrigation than by the use of human refuse as manure in any other way, and probably less if the precaution be taken of not allowing the animals to graze, but always having the grass cut and carried to them.

"*The Sewage of Manufacturing Towns.*"—Mr. W. T. McGOWEN (the Town Clerk of Bradford) read a paper on the above subject, in the course of which he said:—There are few subjects connected with the management of large towns which cause greater embarrassment than that of the disposal in a satisfactory manner of their sewage, especially when it contains the refuse of establishments engaged in the manufacture and dyeing of textile fabrics, where the surrounding district is extensively occupied with dwellings, or the surface is affected by serious variations of altitude. Local authorities are frequently charged with supineness in relation to this branch of their duty; but they are not open to the imputation, and if they were there are influences in operation sufficiently active to forbid all chance of their being allowed to slumber. As a rule they are willing to incur any reasonable trouble or expenditure. The difficulty lies in another direction; they are in perplexity as to what is the proper course for them to adopt; and in the whole range of inquiry to which the labours of the British Association are directed, nothing would confer a greater boon on the country than the settlement of this question in a thoroughly practical manner. The stages by which the matter has assumed its present aspect do not admit of much controversy; the growth of population and the evils arising from neglect of sanitary requirements.

Mr. McGowen then went on at some length to speak of the stages by which the matter has assumed its present aspect; of the difficulties that have to be encountered by large towns; and of the recent attempts to legislate upon the subject. He then referred to the report obtained last session by the President of the Local Government Board, showing what has been done in reference to the purification

of sewage in specified parts of the country. The processes employed are arranged under the heads of Sewage Farms, as adopted in 45 towns; Filtration, as adopted in 54 towns; and Precipitation, as adopted in 30 towns. These do not comprise every place where endeavours are made to deal with sewage, because Birmingham, which has been severely tried, is not even mentioned. The report shows conclusively that the whole subject is yet imperfectly understood, and that what is done is chiefly of a tentative character. The largest town in the list, Leeds, relies on precipitation; but this has been in operation only one year there; and Wilsden, the town which has longest tried a sewage farm, that is from thirty-five to forty years, cannot have achieved a great success, because it is stated in the report that the sewage is merely run over the land, and that on one occasion, when it escaped into the river Peuk, it led to complaint. In none of the cases is sewage in very considerable quantity subjected to treatment. It would be unfair to the gentlemen who advocate the irrigation system to test their views by what is done at Wilsden, because it is admitted by those whose judgment is to be respected that for sewage farms to be efficient the subsoil of the land must be prepared to a proper depth, and with proper material, or not only will the rainfall fill the land with water, and thus reject the sewage, but the sewage will fail to answer the intended purposes of imparting its fertilisers to the earth and the roots of plants, and then passing away purified. On the other hand, it would be equally unfair to local authorities of places like Bradford, and Leeds, and Halifax to assert that what may answer well at Romford or Worthing must necessarily be applicable to them. The difficulties of applying irrigation schemes to the manufacturing towns of this district are most serious. Sir William Denison, when he sat on the Rivers' Commission at Bradford, being asked how much land would be required for the irrigation of the sewage of that town, replied "Ten thousand acres." There is no such quantity of land to be got in the district except at much higher levels than the sewage; land is extremely dear; and being more or less occupied with good dwellings irrigation would lead to endless litigation for nuisances. Any application to Parliament for power to make a large sewage farm in the neighbourhood would share the fate of the Birmingham bill. The irrigation, if resorted to, must therefore be at a great distance, and for every yard of land required for conduit extortionate claims for compensation would be set up; the cost, including arbitration expenses, would be absolutely ruinous; and moreover, the waters would be thus withdrawn from their natural course, where they are indispensable, the streams they now supply, though with an objectionable contribution, would cease to exist, and the industries of the district would be paralysed. Bradford, having been taken in Chancery, agreed to use her best efforts to defecate the sewage of the town. Her case is a good illustration of the capricious state of the law. The sewage is discharged into a stream (the Bradford Beck) for the condition of which she is not answerable; and Dr. Letheby, on a comparative test of the impurity of the sewage and the impurity of the beck, found the latter the worse in the proportion of three to two. The sewage actually improved the waters of the beck. The Corporation, however, could not deny that they sent sewage into the river Aire. They therefore submitted to the above arrangement, and they have spared neither pains nor money to perform it. They carefully considered the best course they could adopt. For the reasons already given, they found sewage farming to be impossible, and they also found that precipitation by the lime process would plunge them into increased trouble, for although the sewage could be cleaned, such an amount of semi-liquid products would be thrown upon their hands as would be beyond their control; the daily discharge of the sewage being about 5,000,000 gallons. After full inquiry it appeared to them the best thing they could do was to contract with the Peat Engineering

Company, by which, under the management of Mr. Dan-
chell, the Company undertake to defecate the sewage,
the Corporation providing the requisite works. Without
entering into minute details, the process of the Company
may be briefly described as being partly filtration and
partly subsidence by means of a catchment chamber by
tanks and other appliances, to which is conjoined a
system of purification by peat charcoal, the power of
which constituent over the offensive properties of impure
air or water is indisputable. This complex operation is
capable of sending off effluent water far beyond the
standard of purity imposed on the Corporation, whilst the
residual products are made inodorous by the peat char-
coal, and are quickly solidified by the mechanical admix-
ture of other ingredients, so as to form a portable manure.
From what has already been stated with reference to
Bradford, it follows that whether the plan which the
authorities have adopted shall prove eminently successful
or a complete failure, the effect upon the river Aire will
be unappreciable, not only on account of the worse con-
dition of the beck, but also from the fact, to be seen on
reference to the accompanying plans, that there are many
other places sending their pollutions into the river besides
the Bradford Beck. The authorities of the neighbouring
districts are fully sensible of their position, and the best
proof of their desire to provide an efficient remedy is that
in 1871 they united in framing a bill for the conservancy
of the Aire and Calder rivers. Instead of meeting with
support from those who had cried out against pollution,
the bill received their strongest opposition, thirty-three
petitions being presented against it. Notwithstanding
this hostility, the promoters would have stood their
ground, more especially as Mr. Secretary Bruce had
promised that the bill should, so far as the Government
were concerned, at least have a fair hearing in committee.
This promise was honourably fulfilled, on an attempt
being made by some of the petitioners to postpone the
second reading for six months. The manufacturers at
Halifax, who are all potent in that borough, then
threatened the Corporation that if they spent any public
funds on the bill the Queen's Bench would be applied to
for a mandamus. The Halifax Corporation were thus
compelled to stay their hand and withdraw. Hudders-
field was on similar grounds compelled to follow suit;
Leeds was in equal difficulty; and Bradford, being
situated only on the Aire, had no case for Parliament as
to the Calder, and so the bill dropped. The principle of
that bill embodies the result of the care bestowed on the
question at the time by the promoters. It is framed upon
a broad and liberal basis. Nothing has since occurred
to show that it was wrong, and the scheme, with one
exception, is now submitted to the consideration of this
meeting as that best suited for this part of the country,
and equally applicable elsewhere.

Having described the general features of the Aire and
Calder Conservancy Bill, Mr. McGowan said—The advan-
tage of the system by which the standard of purity would
be obtained under such a scheme as that proposed by the
Conservancy Bill as against that proposed by the Govern-
ment bills is, that instead of laying down a hard and fast
rule, applicable in some places, but inapplicable in others,
an elastic arrangement is provided, which can be rendered
suitable for every district and its trade. In fixing the
standard some regard should in justice be paid to the
condition of the outfall river; otherwise, as was pointed
out by noble lords in committee, a manufacturer might be
called upon to return water better than he got it, and
better than the river into which it is discharged. A high
standard might be found impracticable at the commence-
ment of the conservancy, and some degree of forbearance
might therefore be necessary; whilst after a given interval
the standard might safely be made more severe; or, on
the other hand, if found to be too stringent, and con-
sequently mischievous, it could be rectified without the
expense and trouble of a fresh Act of Parliament every
time a change was wanted. The prime object of the

scheme was to put all the manufacturers of the district on
the same footing with each other, and render the burden
of purification as light on their shoulders, compared with
competitors elsewhere, as is possible. No man can fairly
deny that the treatment of the sewage of large manu-
facturing towns is a grave subject. It may be that all
tried systems will fail on account of the enormous quantity
of sewage to be dealt with, and the limited superficial
area of England available for its application. Should this
happen, the only remedy would appear to be for the
Government to undertake the construction of main outlets
to suitable points on the coast, where the refuse could
conveniently be used in fertilising wastes of sand, or be
got rid off in the sea, leaving the local authorities the duty
of conveying their sewage to these outlets. This, however,
would necessitate the construction of reservoirs, to re-
plenish the streams whence the waters would be thus
abstracted, and as against the cost to the country might
be set the advantage of allowing anybody along the course
of the sewage channels to use the sewage if he thought fit
to do so under proper restrictions. There is an earnest
desire existing throughout the country to restore the rivers
to a wholesome condition—a desire shared by local
authorities as much as by landowners; but the object to
be attained must be subordinate to some other important
considerations. Manufacturers give employment to vast
numbers of men, women, and children, to whom the
highest purity of the streams would be comparatively of
little moment if their sources of occupation were gone;
the home manufacturer is exposed to keen competition
with his foreign rival, who can work his servants long
hours, and escape from a variety of restrictions to which
his British competitor is exposed. As regards town
sewage, distinguished from manufacturing pollutions, the
refuse must be got rid of somehow or other. It cannot
remain in the town; and the Government, when they
issued their commissions, were so fully sensible of this
that they laid down conditions, which must not be over-
looked by those who are seeking after purity, that by
whatever means the remedy is to be effected, that remedy
must be "without risk to the public health, or serious
injury to industrial processes and manufactures." These
conditions appear to have been lost sight of in the Lords'
bill, and notably so in the circumstance that no new
sewage outlet was to be made in a watercourse, or any
new use made of an old sewage outlet. This would
involve the retention in the town of sewage thus placed
under ban until a scheme of purification was devised and
executed, a state of things which would be past all
endurance. The feeling of the present moment seems to
run high in favour of sewage farming. Without disputing
for a moment the advantages of water as a medium of
transporting sewage, and without entering upon the
question of pecuniary results, the difficulties already
pointed out show that as to many places the sewage farm
is impracticable. To this observation must be added the
important general remark that, if 20 acres per soul be
about the proper scale for scientific sewage farming, it is
doubtful whether sufficient land exists, suitable in point
of level or otherwise, for the undertaking. Those who are
earnest in the matter, and are animated by a desire to
promote the public health in preference to the success of
any pet doctrine, should bear in mind the responsibilities
they incur in pressing forward impracticable measures.
Admitting the fitness of sewage farming properly conducted
for suitable places, there must remain enormous districts
in area and population where the liquid refuse must be
cleansed within a short distance of the outfall. To work
out this task effectually mechanical appliances are in-
dispensable; but it is to the chemist we must look for the
perfection of the undertaking, especially as enabling the
operation to be conducted inoffensively, so as to destroy
smell effectually, so as to speed consolidation of products,
so as to admit of removal profitably, so as to concentrate
the fertilising agents, and satisfactorily as to effluent
waters. And whilst provincial towns are being rightly

looked after by the Government, it should not excite surprise if they draw invidious comparisons between the zeal with which they are pursued and the indifference manifested in the metropolis, where a board enjoying almost unlimited taxing power is allowed to discharge the sewage of three million people into one river, under the very nose of Parliament, and in sight of those equity judges whose decrees are fulminated against the country towns, some of which judges, together with many puissant Lords and gentle Commoners, complacently drink their diluted London sewage whilst severely condemning similar impurity in water used only for business purposes in the provinces. If sewage farming on a large scale is the proper thing, we may fairly ask why the Board of Works has not carried the famous Essex reclamation scheme; or if precipitation or filtration be good, why they have not applied it around Abbey Mills, at Plumstead Marsh, with all the advantages incident to having the highest engineering, mechanical, chemical, legal, and scientific skill ready at command. The fact that no attempt is made by such a powerful authority under such favourable auspices to ascertain whether mere domestic sewage on a large scale can be successfully dealt with, so as to yield profit and avoid fouling streams, is an argument, not that other towns with infinitely great difficulties should go unchallenged, but that they should be treated with consideration; that rash indifference should be avoided; that due regard should be paid to manufacturing interests which are of national importance; and that, as attempted by the Aire and Calder Conservancy Bill, the Government should endeavour to promote amicable co-operation amongst the parties interested, in preference to legislating recklessly or harshly, or thrusting down the throats of honest people dogmas which, after enormous expenditure and infinite discomfort, may prove to be erroneous.

ZINCO-MAGNESIC CHLORIDE.

By GEORGE WARNER, F.C.S.

IN CHEMICAL NEWS, vol. xviii., p. 271, I published a brief note on zinc-baric chloride, and at the same time stated that I had prepared zinc-magnesic chloride. It is prepared by dissolving magnesic chloride in a hot solution of zincic chloride to saturation. The solution of zincic chloride should be concentrated until of 1.6 sp. gr. before the addition of the magnesic salt, by this means avoiding the partial decomposition of the latter, which must ensue during the prolonged evaporation necessary to obtain the right degree of concentration for crystallisation. Upon cooling, a crystalline mass is obtained, which, when drained and re-crystallised, produces the double salt in rhombic prisms with truncated summits, of the composition $\text{ZnCl}_2, \text{MgCl}_2, 6\text{H}_2\text{O}$, or, in 100 parts—

	Found.	Theory.
ZnCl_2	40.29	40.15
MgCl_2	28.07	28.01
H_2O	31.64 by diff.	31.84
	100.00	100.00

This salt is extremely deliquescent, and, compared with other compounds as hygroscopic substances, was found to stand in regard to them as follows:—The figures represent the proportionate quantity of moisture absorbed from the air in a given time, calcic chloride which has been evaporated to dryness and ground taken as a standard.

Calcic chloride	1.00
Calcic chloride, cryst. ..	0.52
Zincic chloride, cryst. ..	1.00
Zinc-baric chloride, cryst. ..	0.40
Zinc-magnesic chloride, cryst. ..	0.59
Magnesic chloride	0.43

Arndwick Bridge Chemical Works,
Oct. 1, 1873.

NOTE ON THE LEAVES OF THE BEECH.

By J. ALFRED WANKLYN.

Corresponding Member of the Royal Bavarian Academy of Sciences.

IN the course of my experiments on different kinds of leaves regarded as material for making tea, I have observed a very interesting fact connected with the beech. Its leaves yield to boiling water 20.8 per cent of extract. This is reckoned on the absolutely dry leaf. The 20.8 parts of extract yield on incineration 2.44 parts of ash, and this ash, extraordinary to relate, is sensibly charged with manganese. Indeed it is quite green from the manganese which it contains. On being treated with water it gives the characteristic red solution of permanganate, which loses its colour on treatment with oxalic acid. The decoction of beech leaves, therefore, contains a quantity of manganese.

Another fact worth noting is the great fragrance of decoction of beech leaves; possibly it might be used as a beverage.

Returning to the chemical aspect of the subject, I cannot let slip this opportunity of recommending a study of the ash of leaves. It is quite to be expected that some of our common leaves may be found to be charged, not with potash, but with cesium or rubidium. That cigar-ash is laden with litbia is indeed known. Perhaps a diligent search into the ash of leaves may disclose new elements. Recent research has brought into prominence the selective power of plants which will refuse to draw soda from a soil that is charged with soda, but will select the traces of potash that it contains.

ON TEA.

By J. ALFRED WANKLYN.

THERE is no doubt that tea is sometimes adulterated with iron-filings and other preparations of iron, and when public analysts have found that iron had been put into tea leaves they have doubtless, in some instances, found that which really had taken place.

The ash of genuine tea leaves, however, contains iron, and by no means a small proportion of it. In a paper by Zöller (*Liebigs Annalen*, May, 1871), the percentage of oxide of iron in the ash of tea leaves is given as 4.38 per cent. The importance of this determination depends upon the circumstance of the tea having been received direct from the growers, who were personal friends of Liebig's; in that instance, therefore, there could be no question of adulteration. It may be interesting to reproduce Zöller's analysis, which is as follows:—

Potash	39.22
Soda	0.65
Magnesia	6.47
Lime	4.24
Oxide of iron	4.38
Protoxide of manganese ..	1.03
Phosphoric acid	14.55
Sulphuric acid	trace
Chlorine	0.81
Silica	4.35
Carbonic acid	24.30
	100.00

From this it is abundantly manifest that the mere qualitative detection of oxide of iron in the ash of tea is no valid proof of adulteration; and that in order to make out a case it is necessary to show sensibly more than 4 per cent of oxide of iron in the ash.

On the present occasion I wish to call the attention of public analysts to the importance of investigating the ash of samples of tea. Zöller found the ash of tea leaves to be 5.63 per cent, using in his investigation tea leaves of

guaranteed purity. I find that commercial tea yields a very similar result, as is seen from the following analysis made in my own laboratory:—

		Percentage of Ash.
Specimen of tea used by myself..		5.63
Civil Service tea		5.56
Horniman's tea		5.99
Mandarin's tea, 8s. per lb. ..		5.30
Orange Pekoe, 5s. per lb. ..		5.84
Do.		6.06
Green tea, 4s. 6d. per lb. ..		5.86

Average .. 5.75

These determinations were made on tea in its ordinary air-dried condition, and agree sufficiently with Zoller's. The proportion of ash in absolutely dry tea is 5.92 per cent.

Zoller further calls attention to the composition of the ash of spent tea leaves. This, as might be expected, is far less rich in alkalis, being far less soluble. Zoller's analysis is as follows:—

Potash	7.34
Soda	0.69
Magnesia	11.45
Lime	10.76
Oxide of iron	9.53
Protoxide of manganese ..	1.97
Chlorine	trace
Phosphoric acid	25.41
Sulphuric acid	trace
Silica	7.57
Carbonic acid	35.28

100.00

This ash, as a matter almost of course, must be composed mainly of material insoluble in water.

For practical purposes, that is to say for use by the public analysts, a complete analysis of the ash would be too cumbersome and troublesome. A great deal of information may, however, be gathered from a tolerably simple operation, viz., from a determination of the relative quantities of soluble and insoluble ash in tea leaves. With the object of rendering a determination of this sort available, I have made such determinations on dried leaves of various kinds. The leaves, with the exception of the tea and Paragau tea leaves, were gathered by my assistant on the 24th of August this year. The following are the results:—

Percentages on the Dried Leaves.
The Ash.

	Total.	Soluble in Water.	Insoluble in Water.
1. Common tea ..	5.92	3.55	2.37
2. Paragau tea ..	6.28	4.22	2.06
3. Beech ..	4.52	2.00	2.52
4. Bramble ..	4.53	1.84	2.69
5. Raspberry ..	7.84	1.72	6.12
6. Hawthorn ..	8.05	3.78	4.27
7. Willow ..	9.34	4.16	5.18
8. Plum ..	9.90	5.66	4.24
9. Elder ..	10.67	3.19	7.48
10. Gooseberry ..	13.50	7.83	5.67

From this table it will be apparent that the ash of Paragau tea is the only ash capable of being mistaken for the ash of tea; the total percentage would of itself exclude all the others. The ash of Paragau tea is, however, distinguished from the ash of common tea by containing a higher proportion of soluble matter.

The ash of beech and of bramble is distinguished from that of tea by being too small in amount, and by containing too little soluble matter. All the rest are exceedingly unlike tea ash.

The determinations of the total, the soluble, and the insoluble ash in leaves are made with great facility. Dried leaves burn up with great ease; and, for the purpose of getting a complete combustion there is no occasion for the

employment of nitric acid. I am in the habit of employing about 2 grms. of the dried leaves for the experiment. These I burn in a small platinum dish, and when the resulting ash has become grey, I allow the dish to cool and weigh it together with its contents. The ash is then heated to boiling with a little water, and the solution filtered, and the filtrate evaporated to dryness in a small platinum dish; the resulting residue is then ignited, cooled, and weighed. Thus I get determinations of "total ash" and "soluble ash"; the "insoluble ash" is found by difference.

Sand is sometimes found in tea leaves; this is very easy of detection. It will, of course, remain in the insoluble portion of the ash, and refuse to dissolve when that is treated with hydrochloric acid. The portion of real tea ash which is insoluble in water is almost entirely soluble in hydrochloric acid.

Very many uses may be made of a determination of the ash in a sample of tea. As an example of what may be learnt from such determinations, I will cite an imaginary case, which, however, finds its parallel in practice. Let us suppose that the tea yielded the normal proportion of ash, viz., 5.75 per cent on the air-dried leaves, and let us suppose that one-third of this consisted of sand. With these data before him the analyst would be justified in finding, not only that there was a little sand in the tea, but that at least one-third of the sample did not consist of genuine tea, but either of some other kind of leaf or of spent tea (which is not so rich in ash as genuine tea).

On a future occasion I hope to publish further researches on tea, and will conclude with an expression of my conviction that a little careful chemical work bestowed on the subject of tea will render the examination of it highly certain and satisfactory.

MEMORANDUM ON THE METALS AND MINERALS OF UPPER BURMA.

By Captain G. A. STROVER, Political Agent, Mandalay.

THE Chief Commissioner having called for a report upon certain mineral products of this country, it has occurred to me that, as many years have elapsed since any concise information has been given upon the subject of metals and minerals generally, and as our knowledge regarding these products has been greatly extended of late in consequence of increased intercourse between the British and Burmese Governments and the subjects of each nation, it will not be out of place, and of some interest, to give a brief sketch of the resources of Upper Burma as regards the same.

Gold.—It has been generally supposed that Upper Burma is not rich in itself as regards this metal, but there would seem to be good grounds for supposing that it exists very extensively. In former years the gold used in the country was imported from China to the extent of some 400 or 500 viss annually, but the imports have considerably decreased since the commencement of the Mahomedan rebellion in Yunan, and now do not exceed 200 viss per annum, the deficiency being imported from Rangoon. It is an article largely used in the decorative art, and appears to be generally plentiful.

In the Mogoung district there would seem to be a gold-field that, if properly worked, would prove very productive. Some years ago, a Mr. Golding, of Australian experience, contracted with the King to work 1 square mile of this field for a sum of Rs. 25,000 annually for ten years, but unfortunately the district proved to be malarious, and Mr. Golding succumbed to fever; he, however, pronounced the fields to be equal to any in Australia, if not better. I am not aware that he succeeded in procuring much gold. Since then no attempt has been made on the part of the Burmese Government to work the mines.

To the north-east of Mandalay, in the Shan States, there is another field of gold. My information tends to show that here again, with energy and enterprise, con-

siderable quantities of gold could be extracted, and the mines prove very productive; but the locality at present is malarious, and but little gold is procured.

At Thayet-pein-yua, near the Myit-Nyay, on the road to Pyawshoo, to the south-east of Mandalay, the gold quartz is found in abundance, the reefs cropping up from the ground, and there is reason to believe that very valuable gold mines are in existence, and could be worked and developed with little trouble. A Shan lately procured from here a piece of quartz 3½ lbs. in weight that produced exactly 2½ ticals of gold.

In the Yaw district, to the south-west of Mandalay, gold is obtained in fair quantities in the alluvial deposits; it exists at Saging, Kannee, Sein-joo, and is also obtained from the Kyend-ween river, and, indeed, it is procurable from the sands of most of the streams between Mandalay and Mogoging. The natural conclusion from this profusion of gold in the rivers and streams of Upper Burmah is that it exists in large quantities *in situ* somewhere, and, as I have explained, this is the case, and doubtless there are more deposits that have not been discovered.

Silver is found in many localities in the Shan States to the east of the Irrawaddy river, but the most prolific mines are those situated at Bawiyne, Kyouktch, and Tounghbyne, near Theebaw, to the north-east of Mandalay. It is mixed with lead, and is in fact a rich argentiferous galena. One mine, the Kampanee, will yield as much as 40 ticals of silver and 25 viss of lead from one basket of the ore, while the poorest mine gives 4 ticals of silver and 30 viss of lead. Other mines exist, such as the Baudween, Baudweengyee, and Saging. The metal is also found in other towns unmined with lead. The supply of silver obtained hitherto has been sufficient for the requirements of the country in conjunction with the imports from Yunnan.

Copper.—This metal is found in the Shan States, but is not worked. It is also found at Kolen-myo and Saging; at Bawiyne and Kolen-myo the malachite appears to be of a rich description. The copper resources of the Shan States do not appear to have been ever utilised to any extent, and the deposits, which seem to be abundant, remain as Nature placed them. The Saging mines were worked in former times by Chinese, but many years have elapsed now since they were abandoned. The surface ore is not promising. Most of the copper used in Upper Burmah is imported from China. It is plentiful in the province of Yunnan.

Iron.—Iron abounds in the Shan States, and the district of Pagan, to the south of Mandalay, is noted for it. A manufactory exists on a rough-and-ready scale in this district at Pohpah Toungh, but the out-turn is inconsiderable. To the west of Saging, for miles up the Irrawaddy river, the ore abounds—a rich hematite. His Majesty is now procuring iron-works from England, and will before long have a large foundry, with all the requisite machinery, erected and at work at Saging. The surface hematite alone will feed it for years to come, if worked. Two mining engineers are now awaiting the arrival of the works, and expect to proceed to Saging soon to commence operations.

Lead is found in abundance in the Shan States, and is extracted from galena. Considerable quantities of this metal could be obtained if such was desired. At present moderate supplies are procured, sufficient for the requirements of the land. It is also imported from Yunnan.

Tin.—This metal exists in the Shan States to the south-east of Mandalay, but the mines have never been worked. The tin consumed in the country now is all imported.

Platinum is said to exist in the Shan States, and it seems probable that it does exist, but I have no reliable information on this point.

Graphite is found to the east of Nat-taik in large quantities on a low range of hills near the village Nyoke-toke. It is not utilised.

Coal.—This mineral is known to exist at Thingadaw, about 70 miles above Mandalay, on the western bank of the Irrawaddy; at Shuaygoo below Bhamo; at Meim-

balong in the Shan States east of Mandalay; to the south-west of Mandalay in the Yaw district, at Yaingaw, east of Nat-taik. It is found at Pagan and Shimpagah, and it is probable that it exists near Meuhla and Yeynang-yung. At Thingadaw the coal has been extracted, but it is of an inferior description, and more resembles lignite than the true mineral coal. An attempt was lately made here to ascertain the productiveness of the coal-beds. It is nearly certain that plenty of coal exists in the locality, and a few more borings would probably prove this. The coal-bed in the Shan States at Meimbalong contains the true mineral coal, and consequently a valuable coal. It has been inspected by an experienced mining engineer, and highly approved of as equal to the best English coal. There is little doubt that the beds are extensive, but unfortunately the distance in land is great, and no easy means are available for transporting the coal to the low lands; indeed, the only method at present is by floating it down mountain-streams and rapids on rafts, which entails considerable risk and loss of coal. European skill and enterprise would soon make a safe route of one description or another if really required by the Government; it remains at present, with neighbouring wealth, where Nature placed it, awaiting development at times to come.

Gade and Amber.—The quality and extent of these mines above Mogoging is well known. They are both extensive and capable of development.

Sulphur.—This substance is not found in mass or in its native state in Upper Burmah, *sui generis*, but is found in efflorescent salts, and is manufactured from metallic sulphures. The following is a list of localities where it is made, and the yearly average out-turn:—

	Viss.
Mooda Myo, N.	3000
Tsein-goon, E.S.E.	2000
Kyook-hoo, S.E.	3000
Bawiyne, Shan States, S.E.	6000
Dybayen Myo, N.W.	4000
Pagan Myo, west bank of the Irrawaddy	4000
Toungthoo Einlay, E.S.E.	4000
From the Bhamo district	2000

Total viss yearly . . 28,000

At Toungthoo Einlay, to the south-east of Mandalay, sulphur is manufactured by the Toungthoo Shans, who sell their out-turn to the King; at all the other places the mines are worked by His Majesty.

The Bawiyne works have been increased during the past month by four extra furnaces, which will give about 5000 viss more per annum. The sulphur ore appears to abound in the Shan States; in fact, at Bawiyne, Kyouktch, Dybayen, Pagan, and Toungthoo Einlay, the supply seems to be unlimited. It is found in the tertiary blue clay from 12 to 20 feet below the surface, which is an alluvial deposit of the old red sandstone; it is embedded in the clay, and consists of very hard metallic pyrites of some size.

The mode of extracting the sulphur is very simple. The sketch below illustrates it:—



Common chatty-shaped vessels are made on the spot from the soft blue clay in which the ore is found. The larger vessel is filled with broken ore, and placed on a fire, a clay retort being fitted to the top, and communicating

with the smaller vessel. The sulphur is thus sublimed and condensed as shown, after which the retort is broken, and a hollow tube of flower of sulphur extracted therefrom which is superior to that condensed in the vessel. Iron pyrites do not appear to be utilised in the manufacture of sulphur, and it is doubtful whether the Burmese could utilise them. These pyrites are to be found in abundance in parts of Upper Burmah and the Shan States. The imports from Yunnan are also considerable every year.

It is manufactured in Yunnan, and in the "Shit-Pyee-Doung," or eight Shan States to the north-east of Bhamo, at present under the rule of the Chinese, or tantamount to the same. European sulphur can be purchased in the bazars at the rate of Rs. 3 per viss.

Saltpetre is manufactured at the following places in Upper Burmah:—

- | | |
|---------------------|-------------------------------------|
| 1. Tounghoo Einlay. | 14. Yoon-doo. |
| 2. Amcerapoora. | 15. Myo-tha. |
| 3. Shimpagah. | 16. Tsit-kine. |
| 4. Ong-ben-lay. | 17. Aloon. |
| 5. Leen-gine. | 18. Tee-ber-Yeen. |
| 6. Sameet-koon. | 19. Myay-Yeen. |
| 7. Pyogan. | 20. Shin-bin-oon-Eni. |
| 8. Aung-gyee. | 21. Yua-shit-gyee. |
| 9. Samoon-gyee. | 22. Enidyne Yuo (Kyook-say, S.E.). |
| 10. Oo-yun-galay. | 23. East of Pagan (Yoong-daw Toun). |
| 11. Shuaybo. | |
| 12. Satoung-ma. | |
| 13. Salem-myo. | |

The yearly average out-turn is about 40,000 viss. The manufacture is not prohibited as with sulphur, and considerable quantities are used in the preparation of fireworks.

The manufactures at Tounghoo Einlay, Eidyne, Kyooksay, Yoongdaw Toun, and Sameet-koon can produce very largely if required.

At Tounghoo Einlay the Tounghoo Shans in former times used to make from 20,000 to 25,000 viss of saltpetre per annum, but emigration to British territory has considerably reduced this.

The price of saltpetre is Rs. 50 per 100 viss. Many parts of Upper Burmah are well suited for its manufacture, the ground being well supplied with nitre.

Rubies, Sapphires, Garnets, &c.—These are found in abundance at Mogoung, Kyat-pyee, to the north-east of Mandalay near Momeit. The ruby ground extends over a large area of hilly country. The gem sand is found from 3 to 15 feet below the surface soil, and the beds are then followed up. The method of working is primitive and rough, the consequence being that large rubies are seldom extracted intact.

Some years ago, a Mr. Bredamajee, a German mineralogist, was located at these mines for the purpose of developing them, but, after a short stay, he got into trouble with the people, and was dismissed.

He declared that, with careful working, rubies as large as pigeon's eggs could be extracted, and that the mines were very rich. At Mogoung, also, ruby mines exist, and very fair rubies have been found. The Sagyeen or marble hills, a short distance to the north of Mandalay, contain the gems as well, but they are of too light a colour to be valuable; they are, however, mixed with other rubies and disposed of.

Salt.—Extensive salt-fields exist at Shimpagah, a short distance above Mandalay, on the western bank of the Irrawaddy river. It is also obtained at other places in Upper Burmah on a small scale. Large quantities can be manufactured at Shimpagah, but imported salt is fast taking its place in the market. The hill people, though, appreciate to a certain extent the Shimpagah salt, and mix it with European salt.

Petroleum.—This mineral oil is found at Yegnanngyoung and Pagan, but information regarding it is so complete that it is hardly necessary to allude to it further. I will, however, make a few brief remarks. There are at present

about 150 wells worked at Yegnanngyoung; the quantity of oil estimated as deliverable from these wells is 15,000 viss daily, of which 10,000 viss is taken by the contractor who supplies British Burmah, and 5000 viss by the contractor who supplies Upper Burmah. The total yield of these wells is 6,000,000 viss per annum, or 9375 tons. There are many abandoned wells, and wells that produce very small quantities of oil. At Pagan there are about 50 wells; they yield daily 1500 viss of oil, which the earth-oil contractors, at present the Lay-myo-woon and one Mung Taanwah, are allowed to purchase. The oil from these wells is obtained in a more liquid state, and more resembles naphtha. It is of a brackish nature, and is better suited for lighting purposes than the Yegnanngyoung oil. The total supply of earth-oil in Upper Burmah now per annum is 6,600,000 viss, or 10,312½ tons.

I have omitted to mention marble and limestone, but both abound.

Upper Burmah, with its metals and minerals, its forests, natural resources, productiveness of soil, and from its geographical position, situated as it is close to the teeming population of the Chinese empire, ought to be the richest country in Asia, and Rangoon one of the largest emporiums of trade. The productiveness of the soil, as regards cereals and other crops, is wonderful. The indigo plant, which is prolific in its growth, gives three crops per annum, and the dye would quite equal that of Bengal with careful and proper treatment in its manufacture. Paddy, wheat, cotton, cutch, grain, sesamum, sugar-cane, tobacco, tea, coffee, each has its own soil in abundance.

Teak and other useful trees abound, and, taking all in all, Upper Burmah would seem to have a grand future in store for it, as civilisation advances and old prejudices give way to new and enlightened ideas.

A few remarks on india-rubber or caoutchouc may be of some interest.

The estimated number of trees, which are chiefly situated in the Bhamo and Mogoung districts, is 400,000. They thrive best in damp moist soil, and in thick forests, shady and cool. The trees attain to a height of from 50 to 100 cubits, being from 15 to 20 cubits in girth at the base (full-grown trees), and with roots creeping over the ground for some distance. They are fit for tapping when from six to ten years of age, at which time they are from 15 to 20 cubits in height and 3 cubits in girth.

When the time for tapping arrives, incisions are made in the trunks of the trees and in the roots above ground. Hollow bamboo cups, about 1½ feet in length, sloped and pointed similar to a prepared pen, are then inserted in the incisions, and receive the oozing juice or milk. Three- or four-hundred of these bamboo receptacles are inserted in each tree. The tapping is continued for about a month, after which time it is discontinued, and the wounds allowed to heal. At the expiration of another month the trees have regained strength, and tapping is recommenced.

In preparing the india-rubber, the following crude method is observed:—Water is boiled in large iron pans, and the juice of the tree is thrown in, when it gradually thickens, and subsequently is dried. The india-rubber so obtained is being brought into local use for covering water-buckets, baskets, and boxes as a substitute for dammer.

The existence of the india-rubber tree in Upper Burmah does not appear to have been known, or, at any rate, it did not attract attention, until somewhat recently, when three Europeans, Messrs. Miller, Marshall, and Henri, who were employed at the jade stone mines, were forced to look and search about in the forests for a substance that would effectually repair a diving apparatus that they used in working for jade stone. They found india-rubber, and repaired the apparatus. The existence and value of the juice was then brought to the notice of the King, and Mr. Henri is now employed in tapping the trees and preparing the juice. Some 70,000 viss of india-rubber was brought from Mogoung last year. I myself saw thirty or

forty cart-loads of it entering the palace one day. Upper Burma could produce 200 or 300 tons of this useful substance per annum.

January 22, 1873.

ON THE ENERGIES OF THE IMPONDERABLES, WITH ESPECIAL REFERENCE TO THE MEASUREMENT AND UTILISATION OF THEM.*

By the Rev. ARTHUR RIGG, M.A.

(Continued from page 178).

THERE are other substances on which this same law, determining the rate at which the affinities are to operate, may be impressed. Gun-cotton is one. We are again obliged to Mr. Abel for two illustrations on the wall showing the destruction of the martello tower at Dinchurch, in Sussex. It was accomplished with 186 lbs. of compressed gun-cotton. And the development of the affinities was such that the tower changed at once into the form you see in the second diagram. Had gun-cotton in the same state of combination and of the same character been put into a cannon, in all probability the cannon would have burst before the ball had time to move.

Some very peculiar and inexplicable affinities are presented by this ally or rival of gunpowder, viz., gun-cotton. In the first place, the rate of combustion and the consequences of it may be previously regulated, and that with much accuracy. Its energy may be mild or great, at the will of the operator. The results of numerous experiments is, that to obtain the full power of gun-cotton it must be exploded in a close chamber, in order that the gases and heat generated by the first part of the explosion may penetrate the mass. The records of experiments with gun-cotton show very plainly the absolute necessity for considering how affinities comport themselves. A bag of gunpowder nailed on the gates of a city would blow them open; a bag of gun-cotton so nailed would fail. Put the gun-cotton in a box, and it will shatter the gate to atoms. A box of gun-cotton flung down close to palisades would open a passage for troops.

Spectrum analysis reveals the fact that the spectrum from the flame of a compound body, as chloride of calcium, is not the same as that observed in the electric spark passing over pieces of chloride of calcium. The explanation suggested is that certain chemical compounds, when they are heated above a given temperature, are decomposed into their constituent elements below that temperature. These compounds are capable of existing in a permanent state. It may be thus with the energy of gun-cotton. When discharged at the temperature of flame, the gaseous constituent elements are not formed, and therefore no explosion. When at the higher temperature producing concussion, then the constituents are formed, and explosion ensues.

You will find that the rate at which gun-cotton explodes depends upon the rate at which the affinities are called into play. Here is a specimen. If we bring the affinities of this gun-cotton into play by means of a spark, and thereby do not produce sufficient heat to develop its affinities rapidly, the rate at which the gun-cotton is consumed is comparatively slow. If we bring its affinities into a flame, the rate at which affinities are developed in consequence of the heat is great. If we bring them into play by means of detonation, the rate at which they are developed is greater still. You see that when a flame is applied to this strip of gun-cotton it runs along it rapidly, whereas when a spark is applied to a piece of the same material the combustion is slow, like touch-paper. If I hold up the string of spark-ignited gun-cotton, the heat gathers, the ignition becomes more rapid, the spark being converted into a flame. Now if instead of allowing the

affinities to be exercised at that slow rate we cause them to develop immediately, we should have had a very different result. Here is some pulp gun-cotton, the very form in which it was used for the destruction of this tower. If we detonated some of that, we should none of us be here to tell the tale of how it went off. There is enough in my hand to send the walls of this room in all directions, but it must be by detonation. The effect of what is something like detonation can be shown in a different form. You are aware that in a coal-mine there are fearful explosions. It has been found that these explosions often take place after a blast in a distant part of the mine. The question therefore is, what has that blast to do with the explosion, the two not being near together? Mr. Galloway, of the Meteorological Office, has been investigating this matter for some time past, and it has been found that these Davy safety-lamps, of which specimens are on the table, are not, when within the influence of a reverberation of the air from the effects of a blast in a distant part of the mine, always as safe as they are supposed to be.

The lamp consists of a flame within gauze; and when surrounded by an explosive compound, owing to the inability of the flame to penetrate the gauze, the explosive gas does not ignite. If, however, detonation takes place, even at a distance from the lamp, then we shall produce those conditions which are favourable to the development of chemical affinity. Here is a Davy safety-lamp, lighted, and now placed in an atmosphere of explosive gas. The question is, what will happen in case a shot is fired in a distant part of the mine? In the case before you the lamp is placed at one end of a long tube, the other end of which is closed by a piece of india-rubber, and in continuation of, but detached from, the long tube there is a short tube of the same diameter. There is no communication whatever between the two tubes, and, as you may notice, there is a space between the ends of them. My intention is to fire a pistol at the open end of the short tube; the explosion will cause the india-rubber to be compressed, and so to act on the air in the long tube. You probably know that if there were on the table a box with an elastic back, and a candle at the other end of the room, opposite to a hole in the front of the box, then by striking the box at the back the candle would be blown out. Now, on firing the pistol, having its end in this short tube, the india-rubber is compressed, and the gas surrounding the Davy lamp, which is supposed to be in a distant part of the mine, at once bursts into flame. This is the same phenomenon that takes place when shots are fired in one part of a mine, and an explosion occurs in another part.

This is all well and good if it would help towards a solution of the question of regulation of the energies of these affinities, if only we could delay the affinities as we delay them in gunpowder, because we might then do what Galileo did when he delayed the ball down an inclined plane; or what Kater did when he caused the pendulum to repeat itself frequently, and so record the effects of gravity; or what Atwood did when he took a small weight and caused that to fall by gravity, but distributed its effect through a large mass. The consequence was that they were enabled to observe what the law of gravity is. If, now, we could rely upon such a process of delaying the affinities as has now been mentioned, we should then have a chance of ascertaining their energies; but we cannot rely upon it, for two reasons. In the first place, there are a number of phenomena classed under the head of nascent actions, which constantly interfere. Let me explain what that is. At the time that certain substances are being formed, certain affinities exist which do not exist afterwards. If, for example, you manufacture hydrogen and then bring nitrogen, from another process of manufacture, into contact, they do not combine. If, however, you manufacture them both in the same vessel, they combine and form ammonia; and hence, in the case of putrefying vegetables, there arises that peculiar

* The Cantor Lectures, delivered before the Society of Arts.

ammoniacal smell. Here is some permanganate of potash, which, when dropped into this tube of coloured liquid, will produce certain phenomena, which take place owing to this nascent action—the colour will be discharged.

Then there are another set of actions which are more peculiar still, which manifest great energy, but which actions interfere with our measuring the energy of affinity as utilised by men. We have here a piece of platinum, and here is an argand burner, connected by a flexible tube with the gas-pipes of the room. Over the argand burner is placed this copper cylinder on three legs, having a wire gauze top. The sheet platinum is now coiled and placed on its edge on the gauze. The tap is opened, and the gas now burns with a lambent blue flame. Observe, the platinum is now being heated; now it glows. Let the gas be turned off. The flame is now extinguished; the once glowing platinum has become black. Thus far is nothing peculiar. Again, the gas is turned on. The black platinum is passing to a dull red; now it glows again, but the gas is not ignited, and the platinum remains at this red-white heat without any apparent cause. If a glass cylinder, to protect it from currents of air, be placed round it, this apparent burning without being consumed will continue during the remainder of the lecture, and, were conjuring tricks an object, it might be said that light and heat were here produced without the destruction of any materials. This is a case of what is called catalytic action. Phenomena like these perplex very much in estimating the energy of affinities.

Here is another case, of a like peculiar character. This is a coil of platinum wire, and you will find that if made red-hot, and then placed in a vessel of ammonia, although there is no gas in it, the platinum continues red-hot. There is no reason, apparently, why it should continue in that red-hot state.

(To be continued.)

CORRESPONDENCE.

THE LATE MR. CHAPMAN.

To the Editor of the Chemical News.

Sir,—That the splendid chemical work with which the late Mr. Chapman has enriched science was carried out in the laboratory over which I presided is almost as well known as the work itself, and most chemists will be surprised to read a biography of that distinguished chemist which describes his having been at school in Heidelberg and attended the lectures of Bunsen and Delffs, and his having studied in the laboratories of Hofmann, Frankland, and Kolbe, but omits all mention of his ever having worked in my own laboratory. Such a biographical curiosity, which may be seen in the last number of the *Journal* issued by the Chemical Society, affords an apt illustration of the real objects which are aimed at by the official body in charge of the Society, and is a worthy sequel to the refusal of the Society to publish one of Mr. Chapman's best pieces of work.—I am, &c.,

J. ALFRED WANKLYN.

O.R. 2, 1873.

MISCELLANEOUS.

Analysis of Milk.—A work by Mr. J. Alfred Wanklyn is in the press, entitled "Milk-Analysis;" it will, we understand, be published in a few days.

Society for the Promotion of Scientific Industry.—In a former number of the *CHEMICAL NEWS* was advocated the establishment of a Society of Manufacturing Chemists. But the manufacturers and promoters of scientific industry of Manchester have gone beyond the

proposed limits, and have established the Society whose title heads this paragraph; they have not confined themselves to the science of chemistry alone, but extend help and assistance to all. The Society is in its earlier stages, but its success would seem to be certain. Founded on the principles of the celebrated *Société Industrielle* de Mulhouse, its object is the increase of the technical knowledge and skill of those engaged in the various industries; the improvement and advancement of manufactures and the industrial arts and sciences; and the general progress, extension, and well-being of industry and trade. This multiple object the Society seeks to attain by the encouragement of investigations and experimental researches in science and the arts, having a practical bearing upon industry; by the offer of premiums and rewards for the invention of new or the improvement of existing processes or products, and for the discovery of new raw materials, and for their application and use; by the reading and discussion of papers and essays of practical interest affecting industry; by the publication and circulation of such papers and essays, with the discussions upon them; by the formation of a library and museum of industry; by the holding of exhibitions; by having agents at the several seats of foreign industry, specially charged to report on all matters appertaining to the work of the Society; and by delivery of a course of technical lectures. The first series of these lectures will be upon the great staple industry of cotton. Amongst the papers to be read and discussed in the ensuing session, the first are:—"On the Economy of Fuel," by T. Prideaux, Esq.; "The Manufacture of Sulphuric Acid," by Frank Spence, Esq.; "The Law and Practice relating to the Protection of Inventions, with some observations upon the Patent Office Museum," by W. Lloyd Wise, Esq.; "The Mechanical Appliances used in Calico Printing," by W. Mather. The work done by the Society includes the sending out of thirty skilled workmen to Vienna to report upon the various great industries shown in the International Exhibition; the arrangements for forthcoming exhibitions in "textile fabrics" and in "fuel economisers." The Society is proposed to be supported by subscriptions and donations. The first year's subscription for a fellowship of the Society is three guineas, one-third of which will be funded; the second and subsequent years' subscriptions will be limited to two guineas. Manchester has the credit of the first step in such an important movement amongst scientific industries. Of the result, it was predicted in our former article that benefit, more or less, must ensue. From such principles, carried out with so much energy and vigour, the most brilliant prospects are a necessary sequence. There are certain subjects of human knowledge and enterprise whose difficulties always succumb to well-directed energy, and scientific industry has hitherto appeared no exception. The volume of Artizans' Reports upon the Vienna Exhibition, published by the Society for the Promotion of Scientific Industry, Manchester, will be published about the 20th of this month. There are thirty-six reports, which are said to be of a very high-class character.

NOTES AND QUERIES.

Gilding.—Will any of your readers tell me how to remove a firm black coating from the surface of gilt on cast copper? A year ago I fixed a cast copper ornament, heavily gilded, out of doors in a clear country atmosphere, and, though ordered to be, and supplied as, weather-proof, it turned colour after first fall of snow, and in three months was black, with what appears to me to have risen through the gilding. It sticks close, and rubbing with cloth and spirits of wine scarcely affects it. Can it be removed by any solvent without affecting the gold, and, if removed, is the same "blackening" liable to recur?—STAR.

Notes on the Utilization of Sewage.—(From the "Report of the Main Drainage Committee for 1864," vol. 487.) 827. (To Mr. Hope.) Then the cost of that has to be added to the 6s. referred to, has it not?—Quite so. Professor Way, in his evidence before the Select Committee of the House of Lords on Town Sewage, put it very clearly, I think, in his answer to question 744. He says: "If you gave me dried sewage, it would be capital manure for any crop, no matter whether wheat or green crops, or grass; it is merely the

form in which you present it that makes it unsuitable for some crops. It strikes me that it is the same kind of thing as if a man were to owe me the value of an ounce of gold, and were to bring it to me in the shape of gold quartz, saying: 'Here is so much gold quartz, which contains £4 15s. worth of gold, or whatever it may be. That would not be paying me at all; I should have to take it with all its disadvantages, and to get it out of the quartz.'

1075. (To the same.) Would it be very costly to pump the sewage up into some reservoir on a height, 10 as to allow it to gravitate all over the country?—No, that is not a costly operation; Cornish engines can be employed, and are employed, to lift enormous quantities of water at very little cost.

1077. (To the same.) Have you made any calculations as to what the cost of the pumping would be?—No, I have not; but I know it is the fact that enormous quantities of water can be pumped to a great height at an almost incredibly small cost.

1118. (To Mr. Moore.) What amount of horse-power do you imagine that the Metropolitan Board of Works would have to use in order to lift the 80,000,000 gallons of sewage 200 feet during the ten working hours of the day?—I have made that calculation, but I have it not with me.

1119. (To the same.) How would you make that calculation?—One horse-power is equal to 33,000 lbs. lifted a foot in a certain time; that is the mode of calculation.

1120. (To the same.) That would be upwards of 800 horse-power net, would it not?—I suppose it would require that.

1121. (To the same.) And it would be about 15,454.5 gross horse-power?—I do not think it would require that for the height.

1122. (To the same.) If it is 15,454.5 horse-power net, how much gross horse-power would it be?—That would depend upon the difference for friction.

1127. (To the same.) You offer the Board of Works a farthing a ton for the sewage, do you not?—Yes, which they would raise with a power equal to 200 feet.

1128. (To the same.) And do you estimate that 156,000 annually?—The half of that would be a profit to them, because it would not cost them one-eighth of a penny per ton to lift it.

1136. (To the same.) How much of the sewage would cultivated land take?—That would depend on the state that the land was in. A market gardener at present manures at the rate of £20 an acre with solid manure.

1137. (To the same.) And you propose to deliver the sewage at a certain price to him?—Yes.

1138. (To the same.) Do you fix any price as the basis of your calculation?—The price to the whole of the consumers is a penny per ton. I do not think that it would answer any farmer's purpose to pay more than that.

1139. (To the same.) How many tons to an acre would you put on irrigated land?—From 4000 to 5000 an acre; that would be about £20 an acre.

1174. (To Mr. Smith.) And what would be the working expenses of your sewage-works, pumping, and so forth?—The sewage-works to lift the sewage proper would cost about 1-12th of a penny per ton of sewage; that is, for coal, labour, and oil, exclusive of the plant.

1180. (To Sir Charles Fox.) Do you propose to pump by steam?—Yes.

1181. (To the same.) What would be the horse-power that you would require?—1,500 nominal horse-power.

1182. (To the same.) Do you assume the sewage to be 80,000,000 gallons daily?—Yes.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in apparatus used in the manufacture of salt. J. Bowen, accountant, St. Mary's Road, Canonbury. February 3, 1873.—No. 399. The features of novelty of this invention consist—First, in arranging the heat flues of salt-panns in a zigzag winding or circuitous direction, instead of the salt being passing direct from the fire to the chimney as heretofore generally practiced; and by these means to utilise the heat that is now lost, and thereby economise the consumption of fuel; secondly, in surrounding salt-panns with some substance or material which is a non-conductor of heat to prevent loss of heat by radiation, also in adapting a cover to the pan to protect it from rain or cold air; thirdly, the formation of a brine-tank immediately above the salt-pan through which the flues in a series of tubes or passages shall pass; the said tubes or passages coming immediately in contact with the brine in the tank will impart to it its heat, and thus increase the temperature of the brine.

Improvements in the manufacture of tin-foil, and in the covering of other metals with tin, also in the machinery or apparatus employed therein. J. H. Johnson, 47, Lincoln's Inn Fields, Middlesex. (A communication from Jean Baptiste Ferdinand Maun, Paris.) February 3, 1873.—No. 406. This invention relates to a peculiar process of and apparatus for manufacturing at one and the same time and in one apparatus, two sheets of tin-foil of any desired thickness, or of coating, if desired, a plate or sheet of any other metal, with tin, by allowing the molten tin to adhere to the sides of a prepared surface which is drawn up vertically through the bath of tin, being divided for that purpose. If a sheet of annealed metal be so drawn up, the tin will adhere permanently thereto and thus cost it.

Improvements in extracting animal grease and other impurities from wool. T. W. Dunn & O. Prangely, both of Trowbridge, Wilts. February 5, 1873.—No. 420.—Wool in its raw state is placed into a chamber into which steam is admitted, and is then pressed.

Improvements in the treatment and use of air for the manufacture of gas for heating and lighting purposes, and in the apparatus employed therein. C. W. Harrison, High Holborn, Middlesex. February 5, 1873.—No. 435. This specification describes a method of oxygenising air by passing it under pressure or otherwise through water or any other suitable liquid that will absorb a larger proportion of the oxygen of the air than of the nitrogen. The air thus oxygenated is recovered from the water by a pump or other suitable means and stored for use in a holder, whence it is conveyed by pipes to where required for use, and is then passed through a suitable hydrocarbon, and thus converted into inflammable gas or vapour adapted to lighting and heating purposes.

Improvements in the manufacture of explosive compounds, and in the apparatus used in such manufacture. S. J. Mackie, 3, Delabury Street, Great George Street, Westminister, London, W. February 6, 1873.—No. 443. This provisional specification describes apparatus for steeping cotton-pulp or waste in an acid bath, placing it in digesting pots, and removing the pots in a cradle by a crane to the cooling pond. Freecing gun-cotton from acid by passing it through rollers. Apparatus for ascertaining the amount of dry gun-cotton in a mass of wet material. Apparatus for granulating compound of cotton gunpowder. Apparatus for giving any desired density to granules of cotton gunpowder.

THE QUARTERLY JOURNAL OF SCIENCE.

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Now Ready, No. XL., October, 1873, price 5s.

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Notices of Books. Progress of the Various Sciences, &c., &c.

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SUPPLEMENT TO THE CHEMICAL NEWS.

VOL. XXVIII. No. 724.

NOTICES OF BOOKS.

Quantitative Chemical Analysis. By T. E. THORPE, Ph.D., F.R.S.E., Professor of Chemistry, Andersonian Institution, Glasgow. London: Longmans, Green, and Co.

We have had occasion to notice the increasing supply of elementary chemical works which have latterly been issued in the British Islands. It may be—as we should be glad to find—that this increase is due to an augmented demand for chemical knowledge; that our delightful science is more and more forming a constituent part of a liberal education, and that those who devote themselves to chemistry as a profession are increasing in number and in public appreciation. Or it may, perhaps, be due to the fact that a smattering of science is fashionable, as it was in the days of Charles II.

The work before us is, however, if fairly used, not calculated to further the production of that very objectionable animal—the smatterer. Thoroughness has evidently been the author's object, and he has been far from unsuccessful in its attainment. If we turn to any of the examples we find the method of procedure clearly and fully described, the needful precautions indicated, and the possibility of failure as far as practicable cut off.

The author uses the most modern nomenclature, and it may be that his work, arranged as it professes to be for the use of artisans, will contribute something to familiarise practical men with this system. At present the "capriciousness of chemical terminology" is not without reason felt to be a grievance of no small magnitude. The question is very generally asked whether the benefits derived from the new nomenclature do more than counterbalance the confusion it has occasioned, and the additional difficulties in the acquisition of chemical knowledge which it has created.

The student who has carefully worked through the examples given in this volume, attending strictly to the instructions given, will be on the high road to becoming an expert and accurate analyst.

The subject of water analysis—no unimportant one in these days of rivers' pollution investigations, and mythological "previous sewage contamination"—is treated, as the preface announces, in considerable detail. We cannot help questioning the policy of attempting to instruct artisans in a process which chemists of the highest standing have after careful trial abandoned as fallacious, because—setting for the moment all other objections aside—the amount to be determined falls within the limits of error of a carefully and skillfully conducted combustion.

In conclusion, we can only pronounce this work a valuable addition to English chemical literature, and congratulate the Andersonian Institution on the style of instruction which evidently prevails in its laboratory.

Sewage: Suggestions for its Utilisation, having special regard to Sanitary Requirements. London: E. and F. Spon.

No better proof can be given of the difficulties besetting the utilisation of sewage than the number of treatises and pamphlets in which the question is discussed. Each author thinks that he has come upon the one essential point which all his predecessors have overlooked. Unfortunately the problem has not been examined with the

calm impartiality befitting men of science grappling with a great national evil. There has arisen an *odium cloacinum* even more rancorous than the well-known *odium theologicum*. The plainest facts have been overlooked or distorted; the strangest inferences drawn; and "recommendations" the wildest and most impracticable have been issued on high authority.

The recent outbreak of typhoid fever in Marylebone has called general attention to a source of danger suspected, indeed, long ago by a few judicious men, but disregarded by the press, the public, and by officialism. Let it be granted that cholera, fever, or other zymotic disease exists in a certain town. The germs of such disease must evidently find their way into the sewers; here they will not, under ordinary circumstances, meet with any agency capable of effecting their destruction. If, now, the sewage is applied, *untreated*, to the land, as in ordinary irrigation farms, these germs must be diffused over the fields. They may adhere to the surfaces of plants, and perhaps may even be absorbed into their capillary vessels. In either case there is no natural process at work by which their vitality is likely to be extinguished. They may thus be taken directly into the human system along with vegetables and fruits that are eaten uncooked; or they may be swallowed by cattle along with turnips, cabbages, Italian rye-grass, &c. Here, again, in the bodies of the cattle they are not, to the best of our knowledge, liable to be destroyed. According to certain recent researches, living bacteria are found in milk as it issues from the udders of female animals, and determine therein the formation of a small amount of alcohol. Such being the case, there is no *a priori* absurdity in the hypothesis that the milk of cattle which have drunk water contaminated with cess-pool matters, or, still more, which have been fed on herbage grown on a sewage-farm, may convey the germs of disease into the systems of human beings. This, it must be remembered, is not one of the cases where the benefit of a doubt can be given to the defendant. If a ship arrives from a port where pestilence is raging, the crew and passengers are placed in quarantine, not because they *have*, but because they merely *may have* about them the germs of the infection. Letters have appeared, indeed, asserting that in such and such quarters the milk from a sewage farm has not occasioned fever. This reminds us of the thief who, when confronted with several witnesses that had seen him stealing a horse, offered to produce as many more who had not seen him. We could lay our finger on certain districts in the eastern counties especially, where the inhabitants derive their supply of water for domestic consumption from road-ditches and duck-ponds, into which the drainage of richly-manured fields and of farm-yards fall, and which stand in indisputable connection with half the cess-pools in the village. Yet in these localities the mortality may be about 15 in the 1000, and the natives may live to the proverbial "age of a crow." Yet we cannot, on the strength of such cases, venture to assert that polluted waters are harmless and that their general use might be permitted with safety. Precisely similar is the case with the use of untreated sewage.

The pamphlet before us points out a way in which this particular danger may be obviated; and thus one at least of the many and formidable objections to the scheme of sewage irrigation may be removed. This has been done at Carlisle. The sewage of that town, before being allowed to flow upon the land, is mixed with carbolic acid, carbolate of lime, and sulphate of magnesia, as patented by Messrs. MacDougall. The disinfection is remarkably complete. No one who has visited the Carlisle farm complains of the "truly mephitic odours," such as the Prussian Commissioner, Lefeldt, laments at Romford, and such as everyone finds at Croydon. The crops, as stated in the pamphlet before us, are:—"Quite free from the rankness and liability to rot of all crops grown on sewage land where the antiseptic treatment is not adopted." Again: "It is also worthy of remark that,

whereas at other sewage farms parasites in the herbage are so abundant that many stock-owners object to pasture their animals on the irrigated meadows, the ravages of the parasites producing liver-rot and foot-rot being so greatly accelerated by the decomposing deposit on the land, at Carlisle the animals have been unusually free from these diseases." These statements are fully confirmed by information which we derive from other quarters. The stems of the grass grown on the Carlisle irrigation farm are not found filled to the height of some inches with unassimilated sewage-matter, nor do cattle, warned by their instincts, turn away from it with disgust. Neither, again, is the land watered with disinfected sewage haunted with those legions of flies and other noxious diptera which, in the vicinage of certain irrigation farms, constitute a perfect Egyptian plague, and which, first sucking up putrescent matters from the damp soil, and then biting the faces of the inhabitants, may at any moment transfer to them the infection of carbuncle, of ophthalmic, and of many other formidable diseases.

The expense of purifying sewage by this method is stated at one penny per thousand gallons, or £4 11s. 8d. per million. Thus, a town turning out 10,000,000 gallons of sewage daily, and disposed to adopt the irrigation principle, would incur for the disinfecting material an additional expense of, in round numbers, £1612 yearly. Against this would have to be set the superior quality of the produce raised, and the saving of stock which would otherwise perish from parasitical and entozoic disease. If sewage irrigation is to be tolerated at all—a point which, in our humble opinion, is by no means decided—it must be on the express condition of preliminary disinfection with the preparation recommended in this pamphlet, or with something analogous in its mode of action.

Our author appears, however, to have overlooked the obvious fact that carbolic acid preparations are by no means exclusively linked to irrigation. They may be, and actually have been, used with great advantage as adjuncts to other methods of treating sewage. When judiciously applied, they extinguish the life of germs and ova in sewage manures as well as in the effluent water. At the same time, unlike certain other disinfectants, they have in the proportions employed no injurious action upon plant life. Messrs. MacDougall were, we believe, the first to draw public attention to the germ-destroying power of the coal-tar products, and by so doing they commenced a new era in sanitary science.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopaedic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgement. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, September 8, 1873.

Fifth Note on Guano.—M. E. Chevreul.—The crystalline matter mentioned in the author's first note is, he believes, a neutral oxalate of ammonia. A fresh sample of guano, of a dull brown colour, and suspected of having been moistened, presented a curious fact. 100 grms. having been five times washed, each time with 100 grms. of water, and thrice more with 200 grms. of water each time, still gave an alkaline reaction. This phenomenon M. Chevreul ascribes to capillary attraction;

a force which he supposes to play an important part in agriculture, as regards soils and manures. In the aqueous extract he suspects the presence of one or more volatile and odoriferous acids, independent of avic acid. The bones of birds found-mixed with the guano are reduced into irregular fragments, angular rather than rounded, of a brownish orange colour. These fragments have no cohesion, and if rubbed with a glass rod in a platinum capsule with a little water they are reduced to orange coloured flakes. The water becomes coloured, and on concentration it is found distinctly acid, and holds in solution an appreciable quantity of phosphate of lime.

Pyrogallol in Presence of Salts of Iron.—M. E. Jacquemin.—According to the author's experiments, ferrous sulphate never takes a permanent blue colour with pyrogallol except when it is partially peroxidised, as is shown by its being reddened by the alkaline sulphocyanides. Of the two he considers pyrogallol the more sensitive reagent for traces of ferric salts. In ferrous-ferric salts the blue colour turns first greenish and then red; 2 per cent of ferric salt is sufficient to produce this change in a few minutes. These red liquors become gradually turbid, and the next day a deposit of purpuro-galline may be separated by filtration. The filtrate on standing grows turbid again, and the second day a mixture of purpuro-galline and tanno-melinate of iron may be filtered off, but on the third day the tanno-melinate alone is formed. After the separation of the purpuro-galline traces of ammonia produce a deep blue-black, which becomes a fine purple-blue on dilution. If the quantity of ammonia is gradually increased the colour produced becomes a violet resembling that of anilin, an amethyst-violet, and a red. With syrupy perchloride of iron a concentrated solution of pyrogallol turns brown. If the solutions are dilute the blue colouration passes rapidly to red. The red obtained by the addition of an excess of ammonia is turned blue by acetic acid, and reddened again by an alkali. The author has likewise studied the behaviour of pyrogallol with ferric cyanide.

Reflections on Spontaneous Generation, in connection with a note by M. U. Gayon.—On the Spontaneous Alteration of Eggs," and a note by Dr. Grace Calvert "On the power of Certain Substances to Prevent the Development of Protozoic Life,"—A Béclamp.—The author states that there are at least three distinct albumenoid matters in the white of eggs; in the yolk, besides the microzymas insoluble in water, there are two bodies soluble in that liquid. He maintains that albumen, gelatin, infusion of yeast, with or without sugar, may be preserved easily in free contact with air. Urine and blood are easily preserved by creosote or phenol. Blood is one of the liquids where bacteria appear the least readily.

Researches on Crystalline Dissociation (continued); Evaluation and Distribution of Work in Saline Solutions.—MM. Favre and Valsion.—When a salt is dissolved in water there is a contraction of the total volume of salt and solvent. But contraction can be produced in water differently, and without a salt, viz., by lowering the temperature. If we measure the number of calories yielded corresponding to a determinate contraction of water, we can estimate the corresponding mechanical work. In accordance with the mechanical theory of heat, if we measure the contractions of volume accompanying saline solutions we have a measure of the coercive action of the salt on the water. This is the principle of the author's work. Having previously studied the solution of sulphate of soda (anhydrous and hydrate) on water, they here similarly study that of a number of other salts. They first determined the densities of normal solutions, or those containing uniformly 1 equivalent of the anhydrous salt (estimated in grms.) dissolved in 1 litre of water; and the densities of the salts. A table gives the densities of the salts considered in the anhydrous and in the hydrated states, and in the state of normal solution. It was

formerly found that a contraction of 1 c.c. in 1 litre of water at a temperature of 15° was equivalent to a liberation of 75.76 calories; and that, conversely, this number of calories measures the work necessary to compress and diminish the volume of 1 litre of water 1 c.c. at that temperature. Hence, to obtain in calories the thermic effects corresponding to different contractions a, b ($a - b$), we have only to multiply these contractions by the constant number 75.76. The numbers for the various salts are tabulated; and a third table gives the quantities of heat liberated or absorbed in the act of solution. It appears—(1) that the salts range in the following order of increasing contraction:—Borates, carbonates, sulphates, chlorides, acetates, bromides, iodides; (2) the contraction produced by solution of an anhydrous salt is greater than that of the same salt hydrated; (3) the contraction from solution of a hydrated salt is generally less than that produced in the formation of crystals; (4) the number of calories measuring the effects of contraction is much higher than the number of calories shown by the calorimeter; (5) the calories shown by the calorimeter have to be added or subtracted, according to their signs, from the calories deduced from contraction. As example of the second case, carbonate of soda (anhydrous) gives in dissolving a contraction of 21 c.c. corresponding to 15.096 calories, but there are 3658 calories set free, and shown by the calorimeter; the work of the solution is, then, represented by the difference, i.e., 115.438. (6) Anhydrous salts generally liberate heat in dissolving; hydrated salts generally give cold. All the salts examined liberate heat during their crystallisation.

New System of Representing Continuous Meteorological Observations, employed in the Algiers Observatory.—M. Buland.—(Note with memoir.)—The author advocates observing and recording the appearance of the sky, in addition to making meteorological observations with instruments. This not only gives more reliable results, but may lead to valuable inductions. Here presents, in a graphic table, the hourly quantity of blue sky and of clouds (the various meteorological elements being also given). The sky is divided into ten equal parts; zero represents pure blue sky, or entire absence of clouds; 1, or ten-tenths, represents the sky covered with clouds. Three principal kinds of cloud (cirrus, cumulus, and nimbus) are represented by different colours. Thus, by simply inspecting the table, one sees how the cloudy periods succeeded each other, or how the periods of blue sky succeeded those of clouds. On comparing the various changes with the oscillations barometric, thermometric, anemometric, &c., one readily sees the connexion with these different meteorological elements. The author desires Government assistance in publishing 12 years' observations at Algiers, in addition to those now issued, which begin January, 1872.

Note on Magnetism.—(Continued.)—M. Gauguin.—Physicists find that in horse-shoe magnets the portable force increases with the time of contact of an armature. The author wished to know whether this increased magnetism would be shown by his method of induction-currents. He placed round one of the branches a loop of wire connected with a galvanometer, applied an armature of soft iron, and observed the current of demagnetisation; first, when magnet and armature had been in contact only a few seconds, and next, when the contact was prolonged several hours or days. The current was always the same, and the result is thus in discord with that above stated. M. Gauguin further determined the curve of demagnetisation of an electro-magnet; placing his wire loop successively at different points of the bar, and observing for each position the strength of induced current developed at the moment of interruption of the inducing current. The curve rises from the ends of the branches, reaches a maximum at a point covered by the bobbins, and then gradually falls to the heel. Thus its inclination changes sign four times throughout the length of the bar. Now

if one examines with a magnetised needle the magnetic state of an electro-magnet, one also finds that the magnetism changes sign four times. Starting from the boreal extremity, for example, the magnetism at the other side of the nearest bobbin is austral, it is zero at the centre of the bar, becomes boreal on approaching the second bobbin, and, finally, is austral beyond this bobbin at the end of the bar. This correlation is a striking one. In the case just described no armature was applied: where there is such, then, to obtain the curve of demagnetisation a new series of experiments have to be made. The loop being placed successively at various points of the bar, one determines for each point the value of the detachment-current (meaning by this the current induced when the armature is detached). By means of this curve, and the curve of demagnetisation obtained when no armature is applied, one may easily trace the curve of demagnetisation for the case in which the armature is applied. Studying this curve it appears that the increase of magnetism near the extremities on application of the armature is enormous; it may be 60 or 100 times the magnetism found before application. In the case of a permanent magnet the increase on application of an armature was not more than five or six times the previous magnetism. From this difference it results that if we compare an electro-magnet and an ordinary magnet by Coulomb's method of oscillations, and the method of weights carried, we should find by the former that the electro-magnet is weaker than the magnet, and by the second that the magnet is the weaker. These results are not in contradiction; the first method measuring the magnetic intensity which exists before the application of the armature, while the carried weight depends on the magnetic state produced after the armature is applied, and, as we have seen, the modification of magnetic state by the presence of an armature is very different in electro-magnets and in magnets.

Spontaneous Ascending Movement of Liquids in Capillary Tubes.—M. Decharme.—The author discusses the formula obtained from theoretical considerations based on experiment.

State of the Volcano of Nisiroi in March, 1873.—M. Gorceix.—This island, one of the Sporades, is situated at the southern extremity of a line running N.N.E. and S.S.W., and nearly perpendicular to the volcanic axis of the Mediterranean. Several of the Sporades have experienced an increase of volcanic disturbance this year. Since historic times Nisiroi has had no eruption with flow of lava till the month of March last.

Researches on the Spectrum of Chlorophyll.—M. Chautard.—This spectrum is characterised by a number of bands, one of which has the special properties of sensibility, sureness (in its division by alkalis, a character not found in the lines of any other organic liquid), and generality. Chlorophyll in plants exists in three different states, distinguishable through the spectrum—in leaves newly formed, in adult, and in dead leaves. In the first case, chlorhydric acid produces *accidental temporary* bands. In the second it produces quite another system of bands, which the author calls *accidental permanent*. In the third (and alcoholic solution) the accidental permanent bands appear immediately, without the intervention of hydrochloric acid. Chlorophyll is much less alterable than is generally supposed. It resists the action of iodine, acids, alkalies, digestive work; at least retaining characters by which it may be detected in mixtures the most complex and varied, and after lapse of considerable time.

New Observations on Presence of Magnesium at the Edge of the Sun; and a Reply to Some Points in M. Faye's Theory.—M. Tacchini.—The author gives observations, from June to end of August, of magnesium line, b , and the line 1474 k , the number of positions each day being noted. These vary from 26 to 60. August shows a maximum. The line 1474 k is always found where the line b is found; but the reverse does not always

occur. Against M. Faye's theory the writer points out, among other things, that the penumbæ of spots are generally very broad, and many of their tongues, or currents, go to the very bottom in a way contrary to that which cyclones would show.

Employment of Chronometers at Sea.—M. de Magnac.—The writer describes observations on board the ship *Jean Bart*; they show that the application of Taylor's series, and of Cauchy's method of interpolation, to the daily working of chronometers gives great precision.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, Tome xxxii., Nos. 3 and 4, September 18 and 25, 1873.

These numbers contain no chemical matter.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, September 3, 1873.

New Derivative of Valeral.—A. Borodin.—The author considers the compound which he obtained to be a polymer of valeral, having many points of resemblance to aldol. It undergoes a spontaneous change in course of time, and deposits crystals of the composition $C_{20}H_{42}O_5$.

Combinations of Bromal and Chloral with Benzol.—Guido Goldschmidt.—The author has analysed and examined diphenyl-tribromæthan, $C_{12}H_{11}Br_3$; diphenyl-trichloræthan; diphenyl-dibromæthylen, $C_{12}H_{10}Br_2$; and diphenyl-dichloræthylen. He has further investigated the behaviour of hydriodic acid, and of sodium amalgam with diphenyl-tribromæthan, and that of zinc-powder with diphenyl-trichloræthan.

Chlorides of Molybdenum.—Dr. L. P. Liechti and Bernhard Kempe.—By the action of dry chlorine, perfectly free from air, the black pentachloride, $MoCl_5$, is obtained, which was formerly taken to be a tetrachloride. If this is reduced by hydrogen gas at the lowest possible temperature, e.g., 250° , the red, sparingly volatile trichloride, $MoCl_3$, is produced. This, if heated in carbonic acid free from oxygen, splits up into the yellow dichloride $MoCl_2$, which remains, and the brown tetrachloride, $MoCl_4$, which sublimes. The last mentioned compound was previously unknown. The atomic weight of molybdenum has been re-determined. Taking $O = 15.96$; $Ag = 107.66$; $Cl = 35.37$; $S = 31.98$; then $Mo = 95.75$ to 95.94 , showing a mean value of 95.86 . The determination of Dumas was 95.65 ; and that of Debray 95.66 to 95.84 . The pentachloride is distinctly crystalline, and can be fused and volatilised without decomposition. On fusion it congeals to a black, radiating, crystalline mass. A green reflection shows the presence of oxychloride. The vapour is a deep brownish red. The sulphur-yellow dichloride and the red trichloride, which strongly resembles amorphous phosphorus, were only obtained amorphous. The tetrachloride appeared as indistinctly crystalline brown sublimes. The di- and trichlorides are perfectly stable in the air at common temperatures, and insoluble in water. The tetra- and pentachloride are easily affected by oxygen, and especially by moisture.

Existence and Dissociation of the Tetrachloride of Sulphur.—A. Michaelis and O. Schifferdecker.—The authors have isolated the tetrachloride of sulphur, and examined its dissociation, and that of the dichloride. The tetrachloride is composed of—

Chlorine	81.61
Sulphur	18.39

100.00

It is a mobile, brownish yellow liquid, quite distinct in colour from the red dichloride. When removed from the freezing mixture it boils up and loses chlorine.

Oxytetrachloride of Sulphur.—A. Michaelis and O. Schifferdecker.—The authors obtained and analysed this

substance to which they assign the formula $S_2O_3Cl_4$. Its composition is—

Sulphur	25.24
Chlorine	55.85
Oxygen	18.91

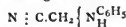
100.00

A white crystalline mass, closely resembling perchloride of phosphorus in appearance, of peculiar irritating odour.

Action of the Sulphate of Soda, and of Sulphurous Acid upon Iodide of Lead.—A. Michaelis and G. Kœthe.—Iodide of lead can be completely transformed by sulphate of soda into sulphate of lead and iodide of sodium. Iodide of lead in the cold is only partially convertible by excess of sulphurous acid into sulphate of lead and free hydriodic acid. At higher temperatures the transformation is almost complete.

Direct Determination of the Constituents of the Carbon Compounds by Combustion.—A. Mitscherlich.—This paper is reserved for full insertion.

On Anilido-Acetonitril.—C. Engler.—This substance, to which the author assigns the formula—



is obtained by the action of anilin upon monochloro-acetonitril. It is a thick yellow oil, insoluble in water and dilute acids, but readily soluble in alcohol, ether, and concentrated acids.

Products of the Reduction of Acetophenon with Sodium Amalgam.—A. Emmerling and C. Engler.—The authors, correcting views they had previously entertained, state that a body which they described as a secondary ethyl-benzyl-alcohol is the pinakon of acetophenon.

On Propiophenon.—T. D. Barry.—The author has formed and examined crystalline nitro-propiophenon, $C_6H_5NO_2.CO.C_2H_5$; a syrupy nitro-propiophenon; amido-propiophenon, $C_6H_5NH_2.CO.C_2H_5$; and the secondary propyl-benzyl-alcohol—



On Sulpho-Ortho-Toluidic Acid.—M. Limpricht.—This acid, $C_7H_5NSO_3H$, was obtained along with a more soluble isomer. Its potassium, sodium, barium, lead, and silver salts were examined. A bromated acid was formed, $C_7H_5BrNSO_3H.H_2O$, and its salts were investigated.

Derivatives of Uric Acid.—E. Mulder.—The substances examined were the dihydrate of urea—



(its aqueous solution gives a rich blue colour with sesquichloride of iron and ammonia), oxoanic acid, and alluranic acid. The latter, a new compound, has the formula $C_5N_2H_4O_4$. The author has also studied—Alloxan-silver; the reduction of alloxan and parabanic acid by hydriodic acid; the oxidation of mycomelinic acid; and the characteristic reactions of alloxantin and dialuric acid. Both give a blue colouration with ferric chloride and ammonia.

Action of Ammonia upon Bromacetyl-Urea.—E. Mulder.—If alcoholic ammonia acts upon bromacetyl-urea in a closed vessel in the water-bath, a colourless product is obtained, insoluble in alcohol. If it is treated with dilute hydrochloric acid, diglycol-amidate of di-uramid dissolves, and there remains a mixture of bromacetyl-urea and another body. From the mixture was obtained a body differing widely from diglycol-amidate of di-uramid in its properties, but not in its composition. The action of aqueous ammonia is different.

Chlorhydrate of Ethylen.—A. Ladenburg.—The author obtains aceto-chlorhydrin, $C_2H_4(OC_2H_3O)Cl$, by heating 1 part of chlorhydrate of ethylen with 14 parts of anhydrous acetic acid in a sealed tube.

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BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

BRADFORD MEETING, 1873.

SECTION B.—CHEMICAL SCIENCE.

PRESIDENT, DR. W. J. RUSSELL, F.R.S.

(Continued from p. 186).

"The Bradford Sewage Works."—Mr. ANDREW LEIGHTON (London) gave a description of "The Bradford Sewage Filtration Works," in the course of which he said that it did not admit of a doubt that the purification of sewage, so that the effluent water could mingle innocuously with any stream, could be accomplished by the Peat Engineering and Sewage Filtration Company; but whether at a profit was an unsolved problem. Owing to the *vis inertiae* of the farmers the sale of the manure was but slow, but the consumption was gradually growing. The principal reason of its sale being so backward was that its chief ingredient was charcoal, which bore no value in the analysis of the agricultural chemist, though the crops grown under the company's manure were the finest in England.

In the discussion which followed on the sewage question, Mr. STANFORD (Glasgow) said that with regard to the general report of the Sewage Committee, he had had the pleasure now of listening to it for several years in succession, and he was very glad to find that the gentlemen, in educating the country, were greatly educating themselves. They were at first, as Mr. Hope had happily expressed it, rather ill-connected, but they had been gradually picking up much better connections. First of all they were to have the country floated with sewage thrown over the fields just as it was, and now they were recommended to separate systems. He had pointed out some years ago that they must have a separate system for the sub-soil water, and one of pervious sewers for the drainage water. They were going now, instead of throwing the water over the land, to have it passed through the land. It was to be filtered, and it was also to be precipitated. All these were great improvements. He was extremely sorry, however, that the gentlemen who had formed the committee were now going to sit in their chairs and throw up any further trouble.

Mr. P. H. HOLLAND (Medical Inspector, London) said Mr. McGowen had very wisely directed their attention chiefly to the part of that very extensive subject in which he was best qualified to speak with authority, and which stood most in need of clear elucidation. Nearly all who had considered the question were well convinced that the proper destination of the very diluted manure called sewage was for the fertilisation of the land wherever land was accessible at a cost which could be repaid by the value of the manure, and, with a few exceptions, all were convinced that the objections urged against sewage irrigation, when properly applied, were either false or frivolous, very similar indeed to those often urged by those very temperate arguers—advocates of temperance—who contended that because drinking to intoxication was injurious, therefore drinking without intoxication was so. By similar reasoning it was concluded that sewage irrigation properly done must be bad, because it would be if so used as to turn a pleasant meadow into a putrid swamp. Now this was exactly the difficulty. Some places were so situated that access to a considerable extent of land could not be obtained except at a cost out of all proportion to the profit to be expected, and until legal difficulties were removed such places were therefore compelled to run the risk either of converting a small area of land into a putrid swamp, or of spending a large amount that would never

be repaid, or of so far partially purifying the sewage that it might without offence be turned into the river, which was perhaps the best course to follow until the legal impediments to a better were removed. The local authorities were now liable to be forbidden by one injunction to turn foul water into a stream, and by another to divert any water from it, thereby diminishing its volume. Those using it for power claimed not merely its natural volume, but any addition that might have been artificially made to it. In the case of Bradford this artificial addition to the dry weather stream had been very considerable, 12,000,000 gallons being daily conveyed from the valley of the Wharfe to the Aire, and any quantity of sewage not exceeding that might be diverted from the Aire without reducing the stream below its natural volume; and no compensation ought to be paid unless the stream were diminished more than it had been artificially increased. Such a conservancy board as Mr. McGowen had proposed, with representatives of each interest affected, could be safely entrusted with larger and more varied discretionary powers than those representing ratepayers only. They should at least have powers throughout the whole of their district similar to those exercised by town councils within their boroughs; e.g., they should be authorised to construct conduits wherever necessary for conveying sewage from the places where it was doing mischief to those where it could most conveniently be disposed of, without paying any other compensation than for land actually occupied, and for damage actually sustained. There need be no payment by a board having perpetual succession for possible prospective damage, as such board could at any time defray any legally-established claim. Such board should have power to purchase or hire by agreement any land suitable for irrigation, on condition that it was so used as not to be a nuisance. No one had a right to prevent another using his land in any way he pleased, merely because he imagined it might prove annoying. He must prove that it was so before he could prevent the land being so used; and it was very certain that the same quantity of manure put in the same land would be less, not more, annoying if it were mixed with a larger quantity of water, provided such water were not allowed to stagnate; and unless the manure were used in excessive and wasteful quantity, it need not be perceptibly offensive at all, and very rarely was so. Although he was not convinced that irrigation of land was the right mode for disposing of sewage, he quite expected that it would ultimately be resorted to for Bradford. He thought no one would doubt the wisdom of trying, as a temporary experiment at least, the possibility of so far purifying the sewage as to postpone the necessity for extensive works, which could not be effected without considerable change in the law; but the necessity of change of law had become so apparent that the representatives of large towns would find it indispensable to take common action, and insist upon such changes being made.

The LORD PROVOST OF GLASGOW said he thought there were two things involved in this question. One was that different towns required different appliances; that one scheme would not do for every place, and that separate schemes were necessary for different towns. There was another conclusion which he thought they had all arrived at, and that was that the return, in a pecuniary point of view, was not likely to be satisfactory. There were one or two questions which he would like very much to ask, because he thought that the report from the general committee required their very greatest attention. He thought that there were some things in the report with which all parties would agree. One was that irrigation could be adopted with great advantage. Constituted as they were in Glasgow, they had in their neighbourhood a large extent of sandy soil, where the sewage could be removed, and in all probability give rise to a very considerable return of crop by being put there. It appeared to be the opinion of the engineers whom they had consulted that the removal of water carriage in that way would be very effective indeed. He quite agreed with the report of the committee that the

conservatism of sewage—that was, keeping it in the same place—must be condemned; at least he might say that, so far as they had found in all their experiments, they had not found one satisfactory plan by which they could recommend that to be put in operation. He would like to ascertain from the committee whether, in the consideration which they had given to the matter of irrigation, they included the chemical refuse in the sewage that they proposed to apply in the way of irrigation, or whether in the refuse of large towns the chemical ingredients would be as effective as if some process were taken to separate the one from the other; also, if they had made any calculation how much an acre of land would bear per annum of sewage; and whether they advocated intermittent sewage or a constant flow of sewage to be put on the same land.

Mr. B. LATHAM, in speaking of the report of the committee, said he did not think that such an association as that should issue dogmas which were not in accord with the experience of the country. One of the things they had been told was that the drainage must be carried out upon all irrigation grounds; but they had not been told in what way that drainage was to be carried out in order to secure the purification of the sewage. It was an important thing, and they all knew that drainage had a beneficial effect in irrigation on the soil, but in some cases it absolutely prevented the proper purification of the sewage. Where the surface of the soil was deep drainage was unnecessary, and where the surface was flat there drainage was absolutely necessary. With regard to the Bradford works, there was no one system which could apply to all parts. There were some cases in which dry conservancy must be carried out in conjunction with some system of drainage, but there was no way in which drainage in some form was not absolutely necessary.

Mr. HOPE (Chadwell Heath) said that as regarded drainage, if it was necessary in ordinary farm land, *a fortiori* it was necessary in clay land and in irrigation. If Mr. Latham was bound to take up his drains, it must be because they had not been properly put in. If they drained clay land they must drain it deeply. If they spent money upon the matter, they would get it properly done. He referred at length to the case of Birmingham, which recently came before Parliament, and of which, having himself been engaged in the proceedings on the bill, he was able to speak from personal knowledge of the details. With regard to the Aire and Calder Conservancy Bill, he did not know much about it, but he had heard that some land-owners were unkind enough to call it a bill founded by the wolf to protect the lamb in the stream. He was sure that no one could look at the town clerk of Bradford and say that he looked like a wolf. He would not admit that there was any town in the country which could not get land if they went to the expense. If there were towns on the upper branches of a river, the waters of which people wished or required to drink, then they must be made to purify their sewage at whatever cost. The cost was a secondary consideration, health being evidently the first. As to the London scheme, he might say that the Metropolitan Board of Works had no power at the present moment to deal with sewage.

Mr. BLAND suggested that it would be better if something could be found out by united efforts which would enable sewage to be efficiently precipitated and purified.

Dr. GILBERT said he understood the gentleman who spoke of the process now being adopted at Bradford to say that the whole of the manurial matters were retained. Without binding himself to any one particular figure, he would say that the sewage, as derived from domestic sources, would not contain more of its nitrogen than one-fourth on the average and even less; but, at any rate not more than one-fourth of it could possibly be precipitated from the liquid and retained in the manure. They had not been favoured with the results of any analysis of the deposited manure, and without those they could not form any definite opinion. With regard to the three-quarters

or more of the valuable matters and the putrescible matters which were left in the sewage after any such process as they had described, the only way and the best way to purify that sewage was by irrigation if it could possibly be carried out. That was the only possible means and the only known means of its utilisation.

Mr. CHARLES ELCOCK (Manchester) hoped that the committee would not cease its labours at the present time. The whole question of the treatment of sewage was one almost as yet in its infancy.

Mr. STANFORD (Glasgow) proposed the reappointment of the committee.

Mr. MCGOWEN (Town Clerk of Bradford), in seconding the motion, said that the discussion which had taken place proved most satisfactorily and conclusively that if the committee which had been appointed to investigate this matter were to bring before the public anything thoroughly practicable and thoroughly useful, they ought to be reappointed again and again until they could arrive, not merely at some sound theories applicable to some districts, but at a good rule that should be applied to districts of special characters in different parts of the country. Mr. Hope had spoken of the land as easily to be obtained, but he ventured to assure him that it was not so. But Mr. Hope had said they might go to miles, and if they could not find it within 10 miles they might go 20. Now there was no magic in that, and therefore he would say that if they could not find it within 20 miles they might go 30. Now could there be anything more rash than such statements from any one coming into this part of the world, seeing how this part of the country was situated, its configuration, and the everlasting changes of altitude? Besides, had anybody ever contemplated the expense which would be the result of such a proposal being carried out? Mr. Hope had given them the most opposite illustration of all the difficulties which surrounded this question that he possibly could have selected. Referring to what Mr. Hope had stated in regard to the case of Birmingham, he said that when it was proposed to convey the sewage into a particular district, gentlemen were sure to say that it would depreciate their property. They might, if they chose to put it so, be as much mistaken in that as it was possible for a man to be mistaken, but he could not believe for a moment that a money object alone guided them. In such cases every man who had a piece of land to sell always declared it to be the best piece of land in the country. But let them look at what that led to. They could not get the land without going to Parliament. They applied for certain powers, and after acquiring the land and erecting the works, they might have a suit in Chancery about once every morning. He concluded by saying that he hoped the committee would look at the question in a serious point of view. The public would not have the streams polluted—let them avoid by all means recommending to enormous centres of industry, surrounded by tremendous difficulties, schemes that were very applicable indeed to sparse populations, but wholly inapplicable to such populations as these.

ON THE ESTIMATION OF CARBON IN PIG-IRONS.

By CHARLES H. PIESSE.

Most persons interested in the analysis of pig-irons have found that the process of filtering the separated carbon through a piece of combustion-tube narrowed at one end and partially plugged with asbestos, mentioned by Fresenius on page 573 of the third edition of his "Quantitative Analysis" (Bullock's translation) is anything but satisfactory. I have been using for several years a modification of that method which has the

advantage of allowing the operation to be rapidly completed. It is as follows:—

Place an accurately weighed quantity of about 3·5 grammes of the pig-iron (fine drillings) into a beaker, and pour upon it about 35 c.c. (10 c.c. for each 1 gramme) of a solution of cupric chloride, which has been made thus:—

Take of—

Cupric chloride	500 grms.
Sodium chloride (saturated solution) .. .	900 c.c.
Hydrochloric acid (ordinary pure, sp.gr. 1·16) ..	50 c.c.
Distilled water	50 c.c.

Dissolve the cupric chloride in the solution of sodium chloride, and add the mixed acid and water. Filter the whole.

This solution should be quite transparent, and it is advisable to test it before use, by pouring some upon a sample of pig-iron known to contain a rather large quantity of combined carbon. Any evolution of hydrocarbons will indicate that the solution is too strongly acid. This only occurs when the cupric chloride contains a lot of free hydrochloric acid. It can be remedied by further drying the CuCl_2 over the water-bath, and making another batch of the solution, in which 50 c.c. of distilled water are substituted for the 50 c.c. of HCl , and then mixing the two batches.

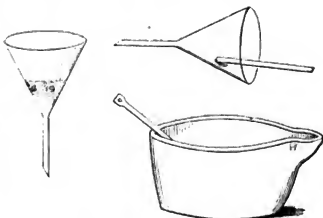
The beaker containing the pig-iron and cupric solution is covered with a clock glass and allowed to stand for 2 or 3 hours in a warm place. By that time nearly the whole of the iron will have been dissolved, the carbon separated, and some metallic copper thrown down. The dark brown liquid produced (which consists of ferrous and cuprous chlorides) is to be very carefully decanted on to a filter directly to be described, a little more solution of CuCl_2 then added to the residue in the beaker, and that in its turn after standing a short time to be also filtered. This fresh addition of CuCl_2 to the residue and subsequent filtration to be made as long as any iron remains undissolved. Generally, however, two or three additions of the solution after the first are sufficient. It is advisable to keep the filter covered with a watch-glass between these successive filtrations to prevent the mass upon it from drying. The carbonaceous residue is then thrown on to the filter, and the beaker rinsed out with a saturated solution of NaCl , and cleaned by means of a cut quill in the usual way. The mass upon the filter is then to be thoroughly washed with the solution of NaCl until no iron or copper can be discovered in the filtrate on testing a few drops of it collected in a test-tube for the purpose, with K_2FeCy_6 and K_3FeCy_6 . The NaCl is then removed by washing with distilled water, and when nothing is left on evaporating 3 or 4 drops of this filtrate upon a platinum spatula, the washing is continued with boiling concentrated HCl (sp. gr. 1·16). This washing with HCl removes a quantity of iron, existing probably as hydrated ferric oxychloride from the unavoidable exposure of the ferrous chloride to the air. The iron being thoroughly removed by the hot HCl , that is now to be most perfectly washed out with boiling distilled water, and when every trace of it is gone, the carbonaceous mass is to be dried at 100°C .

The filter consists of a glass funnel into which a nearly circular slab of glass or porcelain* about $\frac{1}{2}$ inch in diameter has been so placed that it lies horizontally. The slab is covered with a layer of broken, nearly powdered asbestos, from $\frac{1}{4}$ to $\frac{1}{2}$ inch in thickness, that being well wetted with saturated solution of NaCl so as to sink it firmly together. A glance at the figure will render this description clear. A portion of the filtrate from every fresh decantation should be largely diluted with H_2O after adding a sufficiency of NaCl solution or HCl , to keep the CuCl_2 dissolved, and examined by transmitted light; if any particles of carbon are floating in it, the whole must be re-filtered, but if the filter has been properly made this will never happen. When the carbon on the filter is

perfectly dry, the funnel is to be inverted over a Wedgwood mortar containing some cupric oxide; the slab by being pushed from behind with a thick platinum wire falls with the asbestos and carbon on to the CuO in the mortar. The slab is then taken up with a pair of clean brass tongs, and should there be any carbon adhering to it (which but very rarely indeed happens) that is removed by rubbing it in the CuO , or by scraping it with a little clean asbestos. Attention is then turned to the funnel, to which nearly invariably some carbon adheres. This carbon is best removed by holding the funnel horizontally with one hand, and then putting a little CuO over a part of the carbon, covering that with some clean asbestos, and pressing on to it with a small platinum spatula, whilst revolving the funnel slowly, in its horizontal position; after one or two revolutions of the funnel the carbon will be entirely scraped off. To secure accuracy, this operation should be repeated twice or three. The position of the funnel, &c., is shown in Fig. 2.

FIG. 1.

FIG. 2.



The whole contents of the mortar are then thoroughly commingled by stirring with the pestle, the mixture being transferred to a combustion-tube in the ordinary way, and burnt in the style of an organic analysis. It is advisable to pass oxygen for about 10 minutes through the combustion-tube towards the end of the operation, to ensure complete oxidation of the graphitic carbon. By heating the mortar and CuO (which must of course have been previously heated to dull redness to expel moisture) in the water oven to 100°C , this is prevented from absorbing moisture; but, nevertheless, a CaCl_2 tube should be interposed between the combustion-tube and the potash bulbs.

I need hardly add that by multiplying the weight of CO_2 found by 27·27, and dividing the product by the weight of the pig-iron used, the result will represent the percentage of carbon in the pig-iron.

303, Strand, London, W.C.

ON THE ENERGIES OF THE IMPONDERABLES, WITH ESPECIAL REFERENCE TO THE MEASUREMENT AND UTILISATION OF THEM.*

By the Rev. ARTHUR RIGG, M.A.

(Continued from page 191).

GUNPOWDER has been introduced solely for the purpose of illustrating the questions that might arise in reference to the physicist's and chemist's views of affinity, and not for any purpose in reference to its use in mining or war.

If its introduction has made clear that the affinities amongst the atoms of which it is composed may be controlled, that the intensity and rate of its explosion (which is but another name for chemical combination) may be

* The Cantor Lectures, delivered before the Society of Arts.

* Easily made with pincers or champfers from a broken crucible or glass plate.

regulated—that it and its related explosive agents may exercise their affinities without danger—harmlessly and slowly, then the inquiry is at once suggested, on what elements do chemical combinations depend? Why are these combinations accompanied with devastation and ruin. Why are they peaceful and unperceived?

Those who were present at the first lecture will be prepared for the suggestion that these differences arise (in part, at least) from some of those results which in that lecture were said to be deducible from a consideration of the units of time, mass, and space. Those fundamental units form a combination on which all our knowledge of work and production of energy depends. It will probably be remembered, too, that in the lectures on gravity and vitality these units of measurement formed the object of research by the men who have given to society the mode of estimating these energies.

It may have been noticed that whereas in the other lectures of this series the titles have in them the words, "especially with reference to the measurement of it," these words are changed in the title of the present lecture, and there are substituted for them the phrase, "especially with reference to considerations for measuring, &c." It will now be not inappropriate if one or two of the causes which lead to this difficulty in estimating the energies of affinity be made as clear as the competency of your lecturer will permit.

Before entering upon this, it may be well to consider whether the actual putting forth of the energy of affinity is a phenomenon belonging to physics or chemistry. The answer, open to contradiction by many, is that the study of the energies of affinity is a purely physical question, and not a chemical one. For this reason a chemist deals with those combinations in which the constituent elements have passed through such changes that their identity is lost. The chemist is ever dwelling upon changes, and his equations are not the equations of the physicist and the mathematician; they are, by the use of mathematical symbols, the representatives of change, of what affinity has done and completed, and not of that energy with which it has been done and which is to be measured. The energy of affinity either causes or induces these changes, and until that energy has operated chemistry has no standing ground. The energy of affinity opens the gate which separates the domains of the chemist from those of the physicist, and as the physicist is in possession of the matter the chemist must look there before he can take note of those changes he so loves to contemplate.

It is quite true that when the physicist and mathematician attempt to apply those principles which serve so well in investigating the measurement and utilisations of the other imponderables, they are baffled. By the application and study of these principles it is moderately well known how to call forth that which we wish to call forth. The summons being issued, we can rely upon the same result, whatever may be the surroundings. Not so with the energy of affinity; it is now slow, now sudden, now destructive, now restorative, now brought out by heat, now by light, now by moisture, now by sound, now by time, now by the simple presence of another molecule.

It is similar to the other energies with which we are dealing, in that it seems to consist in a species of attraction or its opposite repulsion. Gravity has a power of attraction at all distances; electricity has both attractive and repellant powers, and we may say at all distances; but affinity is limited to molecules so near that we must say that the matters of which they consist are in absolute and perfect contact.

That there is what we call matter—that it is of such a character or nature as that no two particles of it can at one and the same time occupy the same space; that however much a lump of this matter be divided it may still by finer instruments be sub-divided; that by neither mechanical nor chemical means has any one ever yet obtained one such ultimate and indivisible particle of

matter. These are assumptions generally received without controversy.

It is, however, in and amongst these ultimate and indivisible particles of matter that the laws of affinity operate. If we could handle them as we handle the bulks which the aggregation of these particles form, then, probably, all difficulties respecting the laws of affinity would vanish. We cannot handle them. The physicist gives it up in despair; the chemist, however, more venturesome, deals with them. In dealing with them he puts forth a proposition which the physicist knows not how to accept.

Such unions and interlacings as these seem to set at nought the postulate that no two particles of matter can occupy the same space. For the chemist recognises two, three, four, or five particles of matter, seemingly rushing together, and, as far as we know, occupying the very space which a fundamental physical proposition states they cannot occupy. It may, however, be quite true, for telegraphic messages now-a-days run along the same wire in opposite directions at the same time.

If we could but reconcile these views (and they will be reconciled some day), what a change will come over the dreams of scientific theorists, and what a magnificent and splendid territory for scientific research will then be brought into possession.

To return to the difficulties which interfere with an enunciation of the laws of affinity.

It is plain that explosives, as they are called, vary in their manifestations to our senses in respect of intensity (the assumption that the energy of affinity always produces a species of explosion is not a very violent one). But it is not so plain that within themselves the intensity is a constant quantity, and admits of no variation—that whether gun-cotton causes a cliff to crumble as powder into the sea, or flashes harmlessly without even igniting the gunpowder laid on the palm of the operator's hand, the energy of the affinity in the two cases is exactly the same. In fact, affinity can neither be created nor destroyed—it may be resisted, and if the resistance could be measured at the moment affinity may be said to put forth its energy and overcome the resistance; then this is the measure of the energy. Illustrations of this are numerous and convincing. Let a few minutes be given to one.

If a person raises 100 separate 1 lb. weights off the floor on to a table 3 feet high, then, as a measure of the energy expended, we take the work that is done, viz., 100 separate lbs. raised 3 feet, and call the product 100×3 , viz., 300, as the measure of the energy of vitality which thus raised the weights. Suppose, now, the man had been ten minutes in doing this work, then the energy per minute would be measured by the figures 30. Suppose that instead of working at this rate he had lifted all the weights in one minute, the energy per minute would be still measured by the figures 300, and if the rate of work were continued there would have been expended in ten minutes an energy represented by the figures 3000. Thus we may reason until the work, originally done in ten minutes, is done in one second. The measure of the energy in that one second is 300, and in one minute 18,000, and in ten minutes 180,000. The intensity of the energy in this last experiment is 6000 times as great as in the first experiment. Let this illustration suffice to show that to measure the intensity of an energy time must be taken into account if we wish to utilise that energy, or to bring it into calculations.

It will be within the memory of those present at a former lecture that, in the case of the energy of gravity, Atwood brought time in by staying the sudden action of gravity and distributing the fall of a weight through a large mass. Kater brought time in by causing a pendulum to record the number of its vibrations. They dealt with gravity alone, but as we are dealing not only with the energy of affinity alone, but with such concealed and unknown energies as those which

are taking place, whilst the phenomena we are observing are going on. If we could put two substances together, and could guarantee that neither nascent nor catalytic action should be taking place, then we should have an energy responding as a unit to the energy of gravity. So if we could prolong the time we might, somehow or other, get a record of the energy. But that we cannot do, and with all our modern appliances it seems almost impossible to notice the time when affinity begins and ends its work. Under any circumstances it is difficult to notice time, but when the interval is short, what is called the personal error is as great as though the time were long.

A digression may make this clear. Suppose the eye sees an event, a nerve of sensation conveys the impression to the brain, and then a nerve of motion directs the muscles of the fingers to record it. Now, in the case of affinity, before the nerve of sensation has telegraphed to the brain the commencement of the event whose duration we wish to record, the end of the event is there, and the retina has impression superimposed upon impression, and the fingers fail to enter the records. This leads to another difficulty—the nerves of different persons transmit impressions at different rates; hence observations and records of the duration of things seen and heard by two people do not agree, and certain corrections have to be introduced consequent upon these personal differences in the speed of these nerve-conveying telegrams.

As regards mass. Assuming that our investigations are carried on in the same locality, then, speaking generally, mass is fairly measured by weight *in vacuo*. If the bodies we see and handle were units, then we might recognise mass as the weight of the visible body. These bodies are composed of elemental units, the masses of which we cannot see, and affinity deals with these elemental unit masses, and not with the bodies themselves. Certain considerations, based upon numerous observations, led Dalton and others to conclusions in regard to the weights of these ultimate unit masses. Admitting all to be correct, they are not sufficient for the purpose of estimating the energy of affinity through the fundamental units of time, space, and mass.

The failure is thus—Dalton, finding hydrogen the lightest substance, compared all others with it. But what is the actual weight of a hydrogen atom? That we do not know, therefore we cannot know the weights of the other substances which are recorded in this.

If the absolute weight of one elemental unit of any simple body could be had, then, thanks to Dalton and others, the absolute weight of the unit elements of all other bodies is known.

For the purpose of making clear the value of these atomic or molecular elements in reference to their mass and the space between them, let me, at the risk of some repetition, remind you that knowing the weight of one atom or molecule of each of the bodies, the energy of whose affinities is to be measured, and knowing the space between them and through which space these atoms or molecules pass before they coalesce, then the product of these two elements gives the value of the energy in the form of work done. If with this product the time is combined, then not only the energy, but the intensity of the energy is also known.

Now, if we cannot get at the unit masses, how can we possibly get at the distance between them; yet this distance is the space through which these little masses must be carried by the influence of that affinity whose energy is to be measured by the work it does.

When, however, we consider that the waves of light have been measured, the number of them, per inch, stated, their velocity ascertained, we have good grounds for assuming that the masses and distances of the ultimate elements of matter will also be ascertained; then the laws which regulate the energies of such affinities will, most probably, be also ascertained.

Such are some of the preliminary difficulties which

present themselves to those who look in hope to establish the laws which govern the energies of affinity from first principles.

If, however, these laws be enunciated—if they be even approximately attained—it will most probably be through some indirect means, through some other energies from which these energies of affinity may be deduced. In this indirect way the mechanical energy of heat has been measured, and its value is as generally received and acted upon as that twelve pence make one shilling or twenty shillings make one pound.

The source of mechanical power, so far as men utilise it, is in the energies of affinities. To these energies, as formed by the Creator (inherent and primordial), we owe the means by which work is done. Indeed, it is no very bold suggestion to make, that to the exercise, even now, of these inherent affinities, we owe much—it may be all—of terrestrial magnetism and internal terrestrial change and heat; the progress, in the depths of the earth, of these affinities, may be the cause of the variation of the compass; nay, we cannot tell where speculations such as these lead. How the atoms disport themselves we know not; this we do know, that when some atoms meet some other atoms they are as Greek joined to Greek, for "then comes the tug of war."

(To be continued.)

CORRESPONDENCE.

TURACIN.

To the Editor of the Chemical News.

SIR,—On my return lately from Angola, I had an opportunity of purchasing, from the natives in the Market at Sierra Leone, a quantity of the beautiful red feathers of the "platan-eaters;" and, being desirous of verifying the extraordinary results published by Mr. Church in the *Phil. Trans.* for 1869, I gave them to my friend, Mr. Henry Bassett, F.R.S., to examine, and he has kindly supplied me with the following note as the result of his investigation:—

"From 300 feathers obtained 1045 grms. turacin. Two copper determinations, made by fusing with nitre and carbonate soda, washing out with water, then dissolving the oxide of copper in nitric acid, filtering, and precipitating with potash, gave quantities of oxide copper corresponding to 7.6 and 8.0 per cent of metallic copper. Church found 6.0 per cent; on the other hand, the feathers yielded him a larger quantity of the colouring matter. General characters, appearance, &c., exactly in accordance with Church's description; insoluble in benzol, sulphide carbon, tetrachloride carbon. The copper to be unmistakably seen by burning the smallest portion of a feather in a Bunsen burner."

These lovely birds are common on the west coast of Africa, and on that part of it that I am well acquainted with, viz., from Loango, in 5° S. lat., to Little Fish Bay, in 15° S. lat., their loud and prolonged cry is to be frequently heard in the thick forest, where they find their fruit food most plentifully. Over the whole of the country I have mentioned, and for a considerable distance inland, copper is found most abundantly distributed as malachite, or green carbonate; in fact, specks and indications of the green mineral are to be noticed almost everywhere. Whether such is also the case on the west coast, at Sierra Leone, Senegal, &c., where these birds are, I believe, still more usually found, I cannot say; but there is no doubt that in the large extent of country I have mentioned and explored for many years, and where these birds are common, copper is found very extensively disseminated. I am unable to say whether the copper enters their system as a constituent of their food, as suggested by Mr. Church, but I believe it most probable that these birds are attracted by the bright green of the malachite,

and swallow small particles of it with the gravel, &c., that they, in common with all birds, consume with their food.

These red wing-feathers are sold and used by the natives of the west coast as a "feitch," being employed as charms in sickness, &c., and the bird itself in Angola is considered as a great "feitchero," or witch, being said to warn travellers with its loud cry from danger of robbers, animals, &c., lying in wait to attack them; and its cry, if uttered in a village or town, is reckoned as a very bad omen.

Trusting the above notes, in verification and explanation of Mr. Church's singular results, may prove interesting to your readers, I am, &c.,

J. J. MONTEIRO,
Associate of the Royal School of Mines.

AN INDIGNANT PROTEST.

To the Editor of the Chemical News.

SIR,—In the CHEMICAL NEWS of August 8, 1873, an article is published which gives an account of the alleged "discovery," by a French chemist, of a "new" method of estimating iron by means of the decolorisation of the blood-red solution formed by adding sulphocyanide of potassium to one containing iron peroxide.

If you refer to your file of the CHEMICAL NEWS for 1868, you will find published there (I forget in which month) a letter from me suggesting this very operation; and my suggestion was negated in the next number of the CHEMICAL NEWS by (I think) a Mr. Wright, who satisfactorily (to the English chemists) proved that it was "impossible." I quite agree with the Frenchman that nothing is "impossible," but he might have had the justice, and you the memory, to give me credit for the "idea."—I am, &c.,

W. A. ROSS.

Shooter's Hill, Kent,
Oct. 8, 1873.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopaedic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, September 15, 1873.

Products of Oxidation of Meteoric Irons compared with the Terrestrial Magnetites.—According to considerations already developed the terrestrial rocks, taken in their totality, behave like the epidermis of a globe whose lower regions are constituted by masses resembling the meteoritic rocks. Veins of ferrous oxide may be taken to represent the upper portions of veins of massive iron comparable to the siderites. On oxidation under certain conditions the nickel is eliminated. The characteristic structure of meteorites is found to be entirely destroyed by oxidation. A fragment of iron from Chacras was heated to redness for five hours in a current of steam. It was then allowed to cool, the coherent mass of oxide was polished, and then treated with very weak hydrochloric acid according to Widmanstätten's procedure, but no figure appeared.

Preparation of a New Anilin Red.—M. E. Ferrière.—An acetate of anilin is formed, mixed with ammoniacal

hydrate of copper, and saturated with sulphuric acid, when a fine purple-red colour is developed. After concentration the liquid on standing deposits crystals of sulphate of ammonia, which are filtered off. The new anilin-red remains then transparent.

Reply to M. Tacchini's Last Note.—M. Faye.—M. Tacchini had cited (as in opposition to M. Faye's theory) the case of two spots observed by the Italian spectroscopists, in which the internal gyration was in contrary directions, although the spots were in the same hemisphere. The author reproduces drawings of these spots, and points out that one of them is in advanced segmentation; and that one segment is gyrating in one direction, the other in the opposite. Now, only intact spots (as he had before said) should be compared. Then M. Tacchini again insists on the appearance of protuberances where there are not spots. M. Faye, with the view of elucidating this point, makes the following propositions:—(1) The sun's surface is studded with innumerable pores, giving a shagreened appearance. Those with appreciable dimensions have a diameter of at least one second, representing an opening of 167,000 square miles. (2) The spots are enlarged pores. (3) The spots finish as they commence, returning to the state of pores, finally imperceptible. (4) In these successive transformations there is one element which is unchanged, viz., the primitive axis of the pore. (5) There are two zones parallel to the equator where the change of pores into spots is frequent, and where the spots retain enormous size a long time before becoming pores again. (6) Beyond these zones, at the two polar calottes and the equator, the pores only become spots for a few instants. The phenomenon is very rare from 40° lat. north or south in each hemisphere, and beyond 52° the pores never acquire the size of spots. All this being allowed, M. Faye's theory attributes the circulation of hydrogen to the mechanical action of pores, these being considered as vertical cyclones produced by the unequal velocity of contiguous zones of the photosphere. When the pores are accumulated in certain regions they may give exceptional activity to this circulation and produce protuberances. The heliographic distribution of these, therefore, simply indicates pores more or less accumulated. In times of exceptional cyclonic activity groups of pores, and consequently protuberances, should appear near the poles and near the equator, and this agrees with fact. The pores become spots where the cyclones have most stability. These spots produce more marked protuberances than accumulation of pores does elsewhere; but it is by the same mechanical action. In short, the solar vortices, both spots and pores, produce protuberances; hence it is not surprising that protuberances appear where there are no spots. The author adds sketches of the development of a pore into a spot, and the return to the original state.

New Researches on the Analysis and Theory of the Pulse in the Normal and the Abnormal States.—M. Bouilland. (Extract).—The author distinguishes four periods in each "arterial revolution," or the changes occurring from commencement of one pulsation to that of the next. Of the two shocks the first (known as the pulse) is produced by the ventricular systole of the heart; the second results from systole of the arteries (which are passive in the first, active in the second). These two alternating shocks constitute the normal *dicrotism*, of which the abnormal *dicrotism* is merely the intensifying, simple or double, that is affecting either one shock or both. In opposition to Harvey and other physiologists, the author supposes in the arteries an *impulsive* force without which the transport of the blood into all parts of the body could not be effected. The co-ordinated movements of arteries and heart are ruled by ganglionic innervation, but the precise situation of the co-ordinating nerve-centre has yet to be discovered.

Changes of Form of the Comet 1873, IV.—MM. Rayet and André.—This comet (of which a drawing is given), as observed on the night of September 3, had a

tail about 2" long, while the head was about eight or nine minutes diameter. The nucleus, at first in the centre of the nebulosity, had taken an excentric position near the part furthest from the tail. Other details are given.

Motion of an Elastic Wire, one Extremity of which is Animated with a Vibratory Motion.—M. Mercadier.—The author has studied, with the aid of his "electro-diapason" (formerly described), the motion of an elastic wire fixed to one of the extremities perpendicularly to the plane of vibration. Taking any length of wire, one or other of two cases will occur. (1) The wire divides into a certain number of concamerations with a free extremity, the vibration of which, like that of the whole wire, is executed parallel to that of all the points of the diapason. A node seems at greater or less distance from the diapason, the vibratory intensity and amplitude of which are not sensibly altered by the presence of the wire. This case is distinguished as the *normal vibratory state*. (2) The wire presents complex vibratory forms indicating superposition of movements, and sometimes "turning" vibrations. The free end from the last node takes the form of a horn of varying section. This case especially occurs where the wire is thin; and in all such vibratory states (termed *abnormal or transitional*) there is a diminution of the amplitude and intensity of movement of the diapason, which may even extend to extinction. In the present note the normal vibratory state is studied. The number of nodes, the nodal distance, and the length l vibrating freely, depend on the length L of the wire, its diameter, and the number of vibrations of the diapason. From a table of results several laws are deduced.

[D stands for the first nodal distance, or distance from the first node to the second; D the other nodal distances, except the last, called d ; after the last node comes l .] (1) Whatever the length, where the wire vibrates regularly, it always vibrates synchronously with the diapason. (2) For the same wire the nodal distances, except the first D and the last d , are equal. (3) For the same wire, whatever the length, l is constant and equal to the third of the normal nodal distance D . (4) The length of the wire being varied, l , d , and D remain invariable till there is only one node; the distance of the first node from the diapason alone varies. (5) Other things equal, the normal nodal distance of wires of the same nature are to each other as the square roots of their diameters. (6) For different diapasons, the normal distances corresponding to the same wire are inversely as the square roots of the number of vibrations of the diapasons. (7) If the amplitude of the diapason is varied (e.g., by varying gradually the intensity of the pile) the form of vibration of the wire does not change, but the three or four first nodes near the diapason are displaced; removing from, or approaching it, according as its amplitude is increased or diminished. This displacement decreases very rapidly from the first to the last node displaced.

Product of Oxidation of Meteoric Irons; Comparison with Terrestrial Magnetites.—M. S. Meunier.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, September 3, 1893.

On Silver Urea.—E. Mulder.—The author formed a compound of urea and silver by precipitating with soda a mixed solution of nitrate of silver and urea. It is a gelatinous light yellow precipitate. Silver urea is insoluble in water, but soluble in ammonia. It consists of—

Carbon	4.4
Hydrogen	0.8
Nitrogen	9.8
Silver	78.8

and its formula is probably $\text{CO}_2\text{N}_2\text{H}_4\text{Ag}$. It does not explode when heated like silver carbodiimide.

Behaviour of Monochlor-Phenol Boiling at 218° on Fusion with Potassa.—Aug. Faust.—The author finds himself unable to confirm the results of Petersen and

Bähr Predari, who allege that they obtained hydrochinon on fusing monochlor-phenol with hydrate of potassa.

On Oxethenanilin.—E. Demole.—By allowing ethylenoxide to act upon an equivalent quantity of anilin in a sealed tube the author obtained a new base, $\text{C}_6\text{H}_{11}\text{NO}$. It consists of—

Carbon	70.08
Hydrogen	8.31
Nitrogen	10.64

This base is less mobile than anilin, colourless when recently prepared, sparingly soluble in water, alcohol, and ether, but readily in chloroform. The aqueous solution takes a green colour with solution of hypochlorite of lime.

Examination of Human Bile.—Oscar Jacobsen.—The bile appeared as a clear greenish brown-yellow, and perfectly neutral liquid. The specific gravity at 17.5° C. ranged from 1.0105 to 1.0107, and the percentage of solid matter was from 2.24 to 2.28. Only in the first days traces of albumenoid bodies and of leucin were found in the bile. Grape-sugar and urea were not present. Of the better known bile pigments bilirubin and biliverdin were found. The mineral ingredients were:—

	Percentage of the Ash.	Percentage of Dried Bile.
KCl	3.39	1.276
NaCl	65.16	24.508
CO_3Na_2	11.11	4.180
PO_4Na_3	15.90	5.984
$(\text{PO}_4)_2\text{Ca}_3$	4.44	1.672
	100.00	37.620

Very small quantities were found of iron, silicic acid, and magnesia. Traces of copper were sought for on three occasions, and were found on each. The copper was only in the portion of the bile insoluble in alcohol. *Organic Constituents*—3.14 per cent of the dried residue dissolved in ether—

Cholesterol	2.49
Unsaponified fats, with a little oleate of soda	0.44
Leecithin	0.21

3.14
The organic substances insoluble in ether and alcohol formed—Of the solid residue, 10.0. The alcoholic extract—Glycolohate of soda, 44.8; palmitate and stearate of soda, 6.4. On the prolonged boiling of human bile with hydrate of baryta trimethylamin was invariably obtained, whence choline may be regarded as a normal constituent of human bile.

Silico-Acetic Acid and its Ether.—A. Ladenburg.—The ether has the formula $\text{SiCH}_3(\text{OC}_2\text{H}_5)_3$. Its specific gravity at 0° = 0.9283. It is soluble in alcohol, insoluble in water, but is gradually decomposed thereby. The density of its vapour in toluidin vapour amounts to 170.8, H being calculated = 2; and its molecular weight = 178. In other respects it is similar to ortho-silico-propionic ether.

Oxymethan-Sulphonic Acid, and Oxymethan-Disulphonic Acid.—Max Müller.—The author has obtained the two acids, and gives the structural formulae.

Composition of Cascarin.—C. Mylius and E. Mylius.—Cascarin and ricinin are decidedly unlike. Ricinin is a well marked base, whilst cascarin is indifferent to alkalis and acids, and contains no nitrogen. Its formula is $\text{C}_6\text{H}_6\text{O}_2$, and its composition—

Carbon	63.71
Hydrogen	7.97
Oxygen	28.32

100.00
Product of the Oxidation of Caryophyllin.—E. Mylius.—The author obtained and examined caryophyllinic acid, $\text{C}_{20}\text{H}_{34}\text{O}_6$, composed of—

Carbon	65.22
Hydrogen	8.69
Oxygen	26.09

100.00

The salts of soda, silver, and baryta were likewise prepared and analysed.

On Nitro- and Amido-Benzylamid.—Julius Strakosch.—The author has prepared and analysed the hydrochlorate of secondary nitro-benzylamine, the free base itself, $C_{14}H_{13}N_3O_4$; tertiary nitro-benzylamine, $C_{21}H_{18}N_4O_6$; secondary amido-benzylamine, the hydrochlorate of which is $C_{14}H_{20}N_2Cl_2$; tertiary amido-benzylamine, $C_{21}H_{24}N_4$; hydrochlorate of nitro-benzyl-phenylamine, $C_{13}H_{13}N_2O_2Cl$; and hydrochlorate of amido-benzyl-phenylamine, $C_{13}H_{16}N_2Cl_2$.

On a Polymeric Modification of Isobutyl Aldehyde.—G. A. Barbaglia.—The author acted upon isobutyl aldehyde with bromine and iodine, and obtained polymerised modifications melting at 60° C., very permanent, reducing salts of silver slowly without forming a silver mirror. The variety polymerised by bromine gave—

Carbon	66.666
Hydrogen	11.111
Oxygen	22.223

100.000

It is probably a tri-molecular modification of isobutyl-aldehyde.

Action of Pyromellithic Acid upon α -Naphthol.—Julian Grabowski.—The following is a conspectus of the substances formed and examined:—

1. Di- α -naphthol-pyro-mellithic acid —
 $C_{10}H_6O_8 + 2C_{10}H_8O - 2H_2O = C_{30}H_{12}O_8$
2. Tri- α -naphthol-pyro-mellithic acid I —
 $C_{10}H_6O_8 + 3C_{10}H_8O - 3H_2O = C_{40}H_{18}O_8$
3. Tri- α -naphthol-hemianhydrid-pyro mellithic acid —
 $C_{10}H_6O_8 + 3C_{10}H_8O - 4H_2O = C_{30}H_{12}O_7$
4. α -, β -, and γ -tetra- α -naphthol-hemianhydrid-pyro-mellithic acid —
 $C_{10}H_6O_8 + 4C_{10}H_8O - 5H_2O = C_{40}H_{18}O_7$
5. Pyro-mellithic-tetra- α -naphthol-anhydrid —
 $C_{10}H_6O_8 + 4C_{10}H_8O - 6H_2O = C_{30}H_{12}O_6$
6. Phthaleindi- α -naphthol —
 $C_8H_6O_4 + 2C_{10}H_8O - 2H_2O = C_{28}H_{18}O_4$
7. Phthaleindi- α -naphthol-anhydrid —
 $C_8H_6O_4 + 2C_{10}H_8O - 3H_2O = C_{28}H_{16}O_3$
8. Carboneindi- α -naphthol-anhydrid —
 $CO(OH)_2 + 2C_{10}H_8O - 3H_2O = C_{21}H_{12}O_3$

Combinations of Chloral with Sulphuric Acid.—Julian Grabowski.—A compound of this nature is obtained by the action of anhydrous sulphuric acid upon chloral. It has the formula $C_{10}H_6Cl_2S_2O_6$. It is the most permanent of all the sulphuric compounds of chloral. If cautiously heated with alcohol it dissolves and crystallises out unchanged on cooling.

Reply to Couper's Reclamation on the Preparation of Magenta without Arsenic Acid.—A. Brüning.—The author declares that his procedure, though founded on the same reaction, is essentially different from that of Couper, producing magenta at a far lower price, and of much superior quality.

Laws Governing the Molecular Rotatory Power of Tartaric Acid and its Salts.—H. Landolt.—This paper is not adapted for abstraction.

Nature of the Elements.—G. A. Groshans.—A mathematical paper, likewise not suited for abstraction. The author concludes with the remark that if the specific volumes of two bodies which differ from each other by an atom CH_2 , or an atom of any other element or other atomic group from their respective boiling-points, remainders are occasionally obtained which may be considered as approximately equal.

Benzylised and Dibenzylised Acetic Acid.—Lydia Sesemann.—The authoress, an alumna of the University of Zurich, has obtained benzyl-acetic acid, $C_9H_{10}O_2$, and dibenzyl-acetic acid, $C_{12}H_{16}O_2$, and is at present engaged with studying the most important derivatives and metamorphoses of the latter.

Examination of Certain Bodies of the Camphor Group, Carvol and Carvacrol.—Aug. Kekulé and A. Fleischer.—Carvol is obtained by fractional distillation of the oil of caraway, and boils at 224.5°. It was converted into carvacrol by the action of ortho-phosphoric acid. It boils at 232° to 232.5°, and is isomeric with thymol. Neither carvol nor carvacrol yields any well-characterised product with oxidising agents, except oxalic acid. Perchloride of phosphorus acts upon carvacrol in the same manner as upon the more simple phenols. The sulphacid of carvacrol is solid and crystalline, and its salts can be obtained in fine crystals.

On Bromo-Campho-Carbonic Acid.—J. de Santos e Silva.—The action of bromine upon campho-carbonic acid is very energetic, hydrobromic acid being evolved. If the mixture heats decomposition takes place, but if the temperature is kept down a crystalline yellowish product is obtained, perfectly soluble in dilute soda or potash-lye. From this solution hydrochloric acid throws down mono-bromo-campho-carbonic acid as a white powder, —
 $C_{11}H_{12}BrO_3$

On Terebic and Pyroterebic Acids.—W. Carleton Williams.—Pure terebic acid melts at 175°, whilst Caillot gives 168°. The statement of Svanberg that terebic acid yields both terebates, $C_7H_8MO_4$, and diaterbates, $C_7H_{10}M_2O_8$, was confirmed. Pyroterebic acid was obtained by the dry distillation of terebic acid; it boils at 210°. With bromine it combines to form dibromocarbonic acid.

On Ethyl-Crotonic Acid.—W. Petrieff.—Ethyl-crotonic acid is isomeric with pyroterebic acid. On fusion with potassa it is split up into acetic acid and butyric acid, the latter probably the isobutyric.

Derivatives of Normal Propylic Alcohol.—H. Römer.—The author, acting on propylic alcohol with phosphene gas, obtained chloro-carbono-propylic ether, and a liquid heavier than water, burning with a green flame, and giving off a pungent odour. Its formula is $C_4H_7ClO_2$.

Action of Bisulphide of Carbon upon Para-Nitranilin.—A. Brückner.—A preliminary communication.

Certain Homologues of Oxaluric Acid.—W. H. Pike.—This has already appeared in our columns.

New Synthesis of Propionic Acid.—J. H. van Hoff.—The acid was found among the products obtained by exposing to heat oxalate of potassa and dry sodium ethylate.

Contributions to the History of the Polythionic Acids.—W. Spring.—The author has studied the action of chloride of sulphur upon the sulphites. Among the results were trithionate of potassa, and hyposulphite of potassa.

Certain Derivatives of Benzophenon.—Julius Beckmann.—On treating benzophenon with fuming sulphuric acid the author obtained a body, $C_{17}H_8SO_3$. Its lead and baryta salt were formed and analysed, and it was submitted to the action of pentachloride of phosphorus, yielding a new body not yet fully examined.

Cyan Derivatives of Acetaldehyde and Aldehyde-Ammonia.—F. Urech.—By mixing equivalents of acetone, CNK and CNOK, with acids acetonil-urea was obtained. To prepare lacyl-urea instead of the aldehyde, which easily becomes resinous in a basic liquid, its ammonia compound was used. In this manner lacyl-urea was prepared, which the author had previously obtained from CNOH and alamin.

On Nitronaphthol.—R. Biedermann.—The author has examined the compounds of nitronaphthol with

potassium, sodium, ammonium, barium, calcium, lead, and silver. A bromated substitution product, bibrom-naphthol, $C_{10}H_7Br_2OH$, was also obtained and analysed.

A Reply to Barbaglia.—G. Krämer.—A controversial paper on isobutylic aldehyd and isobutylic alcohol.

New Resin Acid—the Podocarpic.—A. C. Oudemans, jun.—The composition of the acid may be expressed as $C_{17}H_{22}O_3$. It fuses at 187° to 188° , and is not decomposed below 330° . Several of its salts and its nitro and sulpho derivatives have been examined. The acid was obtained from a kind of resin extracted from a Japanese tree, *Podocarpus cupressina*.

Constitution of Podocarpic Acid.—A. C. Oudemans, jun.—A continuation of the foregoing paper.

Base from Nitrobenzanilid.—H. Hübner and H. Retschy.—The authors have examined the salts of the base $C_{13}H_{10}N_2$.

Javanese Cinchona Barks.—Jul. Jobst.—A paper chiefly of pharmaceutical and botanical interest.

Annalen der Chemie und Pharmacie, band clixviii., heft 2 and 3 (Neue Reihe, band xcii., heft 2 and 3), August 30, 1873.

Preparation of the Sulpho-Acids.—W. Hemilian.—The author modifies Strecker's method by operating upon the haloid derivatives of organic compounds with the sulphite of ammonia instead of the sulphite of potassa.

On certain Haloid Derivatives of Toluol.—Dr. E. Wroblewsky.—The author describes first the bromated, and then the chlorated, compounds of toluol. He has formed and examined—Aceto-meta-brom-para-toluidin— $C_6H_3Br_m(CH_3)NH(C_2H_5O)$.

Meta-brom-para-toluidin, $C_6H_3Br(CH_3)NH_2$; with its nitrate, $C_7H_6BrNH_2NHO_3$; its hydrochlorate— $C_7H_6BrNH_2HCl$;

its acid oxalate, $C_7H_6BrNH_2C_2H_2O_4$; its acid sulphate, $C_7H_6BrNH_2H_2SO_4 + H_2O$. Meta-brom-toluidin— $C_6H_5Br(CH_3)$;

with its lime salt, $(C_7H_4BrO_2)_2Ca + 3H_2O$; and its baryta salt, $(C_7H_4BrO_2)_2Ba + 4H_2O$. He has further obtained—The hydrochlorate of brom-toluidin; the nitrate; the baryta salt, $(C_7H_4BrO_2)_2Ba + 4H_2O$. The author next describes the reactions of—Diazo-meta-brom-toluidin; meta-brom-para-iodo-toluidin, $C_6H_3I_pBr_mCH_3$; the nitro-para-iod-meta-brom-toluidin, $C_6H_3NO_2I_pBr_mCH_3$. He examines the preparation of meta-brom-toluidin on the decomposition of diazo-meta-brom-per-bromide, and the preparation of meta-brom-toluidin from ortho-toluidin; aceto-meta-brom-ortho-toluidin— $C_6H_3Br_m(CH_3)NH(C_2H_5O)$.

Meta-brom-ortho-toluidin, $C_6H_3Br_m(CH_3)NH_2O$; its hydrochlorate, $C_7H_6BrNH_2HCl$;

and sulphate, $(C_7H_6BrNH_2)_2H_2SO_4$. Meta-brom-ortho-iod-toluidin, $C_6H_3Br_mI_o$; nitro-meta-brom-ortho-iod-toluidin, $C_7H_6NO_2Br_mI_o$; meta-brom-ortho-cresol— $C_6H_3Br_m(HO)C_6H_3$.

The sulpho derivatives of meta-brom-toluidin; with the α barytic salt, $(C_7H_6BrSO_3)_2Ba + H_2O$; the potash salt; the β barytic salt, $2[(C_7H_6BrSO_3)_2Ba] + 3H_2O$; the β lead salt, $(C_7H_6BrSO_3)_2Pb + 3H_2O$; the β lime salt, $2[(C_7H_6BrSO_3)_2Ca] + 5H_2O$; the β potassic salt, $C_7H_6BrSO_3OK$. The ortho-sulpho-meta-brom-toluidic acids have the constitution 1:2:3 and 1:3:6, and both, therefore, yield salicylic acids. The γ barytic salt— $2[(C_7H_6BrSO_3)_2Ba] + 5H_2O$;

nitro- β -meta-brom-ortho-sulpho-toluidate of baryta— $2[(C_7H_5NO_2Br_mSO_3)_2Ba] + 7H_2O$;

and the lead salt $(C_7H_5NO_2Br_mSO_3)_2Pb + 3H_2O$; and the corresponding lime salt— $2[(C_7H_5NO_2Br_mSO_3)_2Ca] + 9H_2O$.

Meta-brom-toluidin was found to yield two nitro-derivatives— α , solid, and β , liquid. The author next examines—Ortho-brom-toluidin and its derivatives, particularly ortho-brom-

toluidin and the results of its oxidation; dibrom-toluidin; the preparation of ortho-brom-toluidin from meta-toluidin; ortho-brom-meta-toluidin, with its nitrate. He next investigates para-brom-toluidin and its derivatives— α solid para-brom-ortho-nitro-toluidin; β liquid para-brom-meta-nitro-toluidin; α -para-brom-ortho-toluidin; β -para-brom-meta-nitro-toluidin, with the α and β nitrates. The author remarks that the theory of the aromatic compounds indicates the existence of six isomeric dibrom-toluids. He next proceeds to the tribrom-toluids, and to the chloric substitution-products of the isomeric toluidins and of their derivatives.

On Selenic Acid and the Seleniates.—Dr. v. Gerichten.—In this paper the author gives a simple and certain method for the preparation of hydrous selenic acid. His attempt to produce the anhydrous acid yielded a mixture of the substance sought and of selenious acid. He finds it possible to prepare alums in which selenic acid replaces either the sulphuric acid in combination with potassa, or that united to alumina. The same result may be attained with the double salts of the formula— $m_2K_2O.M_2O_4 + 6H_2O$.

It is possible in all these salts to replace the sulphuric acid, molecule for molecule, by selenic acid, and the prodigious mass of salts thus obtained are all isomorphous with the two extreme members of the series—the pure sulphuric and the pure selenic double salts.

Action of Trisulpho-Carbonate and Sulpho-Carbamate of Ammonia upon Aldehyds and Aceton.—E. Mulder.—Acetonin was obtained by the action of ammonia upon aceton, and subsequent addition of aqueous oxalic acid, and its trisulpho-carbonate was then formed and examined.

New Formation of Ortho-Toluidic Acid.—R. Fitting and W. Ramsay.—This paper is not suitable for abstraction.

On Meta-Toluidic Acid.—C. Boettinger and W. Ramsay.—The authors find that what Ahrens and Tawildarrow took to be pure meta-toluidic acid was a mixture of this salt with more or less para-toluidic acid.

MISCELLANEOUS.

Prize List of the Société Industrielle de Mulhouse.—The following is a translation of the list of prizes offered by this Society; with very few exceptions, they are open to general competition. They will be decided in May, 1874. There are three classes of medals, all of bronze, but differing in size:—Medals of honour; 1st class medals; and 2nd class medals.

GENERAL PRIZES.

CHEMICAL ARTS.

1. An essay on the theory of the manufacture of Turkey red. (1st class medal.)
2. A theoretical essay establishing the chemical constituents of the substance, or substances, which accompany alizarin in garancin, and which, in concert with this colouring matter, produce the dyestuffs called garancin. (1st class medal.)
3. For the manufacture and delivery to the calico manufactories of Alsace of an artificial product, capable of entirely replacing the colouring matter of garancin, and which, both as regards price and quantity is fitted for industrial purposes. (Medal of honour.)
4. For the preparation of vivid lakes from garancin, both red and violet. (Medal of honour.)
5. For a substance which can be used to thicken colours, sizes, or dressings, and which will replace, at a saving of at least 25 per cent, all the substances hitherto employed for these purposes. (Medal of honour.)
6. For a substance which can replace the dry albumen of eggs in the manufacture of printed calicoes, and give a large saving on the price of albumen. (Medal of honour.)
7. For colourless albumen from blood, which will not colour by evaporation. (Medal of honour.)
8. For an important improvement in the bleaching of wool or silk. (Medal of honour.)
9. For a method of bleaching which will remove from unbleached cotton all amyaceous substances, without injuring the tissue, and without any great increase of expense. (Medal of honour.)
10. Essay on the employment of resins in the bleaching of cotton fabrics. (1st class medal.)

THE CHEMICAL NEWS.

Vol. XXVIII. No. 726.

THE POLLUTION OF RIVERS' BILL.

WE were all perfectly aware, years ago, that the condition of most English rivers is a danger and a disgrace. Nevertheless, unwilling or unable to trust our own eyesight and our own noses, there was sent out a Royal Commission of inquiry, to whom, for repeating some of the stalest possible truisms have been given—not the proverbial "pinch" due to the bringer of old news. The requirements of red tape having been thus scrupulously fulfilled, we are at liberty to believe that our streams are foul, and to legislate for their restoration to a state of natural purity. Judging from the bill before us there is imminent danger that the remedy may be worse than the disease—that a law may be enacted which will hamper and annoy our manufacturers, give rise to an abundant crop of litigation, and yet decidedly fail to effect the reform desired.

The Select Committee of the Lords appointed to reconsider the first draught of the Bill have sinned against better light and knowledge. In addition to the Reports of the Rivers' Pollution Committee—costly at least, if not valuable—and to its natural appendix, the evidence of Dr. Frankland, they had the independent testimony of Mr. Lyon Playfair; of Mr. J. C. Stevenson, M.P., the representative of the Alkali Manufacturers' Association; of Mr. R. Nichols, an eminent tanner, of Leeds; of Mr. J. Botterill, who may be considered as the spokesman of the Yorkshire dyeing interest; of Mr. R. B. Sanderson, the representative of the coal trade of Northumberland and Durham; of Mr. Ball, Mayor of Newcastle; of Mr. J. Evans, F.R.S., on behalf of the paper trade; of Mr. Crookes; besides other witnesses of less moment. Yet, after hearing this evidence, the Committee have persisted in including as their definition of "polluting liquids"—the entrance of which into any stream is declared penal—the notorious "recommendations" of the Rivers' Pollution Commission! The only modifications adopted, in order to bring these proposals into some little harmony with the necessities of the situation, are the introduction of a clause prohibiting liquids which display a film of petroleum on their surface, and the omission of the clause forbidding all fluids which show a distinct colouration in layers of 1 inch deep, and of the exclusion of any liquid holding in suspension 3 parts by weight of dry mineral matter in 100,000.

The objections against this code, which must by this time be familiar to almost every man of education in the kingdom, have never been faced, least of all by its authors. We have asked—On what principle have the numerical limits fixed in this document been selected? Silence has shown that with the Commissioners and their friends "reasons are not as plentiful as blackberries." We have shown that the term "organic nitrogen" includes substances highly dangerous, and bodies, like urea, which are no more to be dreaded than pre-formed ammoniacal salts, or than the nitrates and nitrites in the effluent water from an irrigation-farm. No one has come forward to defend the classification we have attacked. We have pointed out that, whilst (Recommendations, §4) arsenic is rigorously excluded, yet copper, lead, and chrome are, by §3, placed on the same footing as such comparatively harmless matters as manganese, iron, and aluminium. To this inconsistency Mr. Crookes, in his evidence before the Select Committee of the House of Lords, called special attention: "There is no difficulty in keeping arsenic out; but it is strange that whilst arsenic is specially provided against, other metals which are almost as injurious, such, for

instance, as copper, lead, and chromium, are allowed to slip through. Those three metals ought to be looked after as sharply as arsenic." Dr. Lyon Playfair also recommends the exclusion of copper and lead. Yet this advice has been strangely ignored. So strange is the above omission, and so obstinately is it persevered in, that we cannot help pointing to the fact that certain mountain-waters contain traces of copper and lead, and that any very stringent law against the presence of these metals might be hereafter inconvenient to all who wish to force these waters upon the Metropolis.

But without further criticising errors of detail, so open and palpable that those who cling to them have some claim to a place amongst psychological curiosities, let us at once go to the root of the matter. This was pointed out by Mr. Crookes in his evidence: "The bulk of the liquid sent into a river is quite as important as the degree of its pollution. If the river is a tolerably large one a thousand gallons or so of most offensive liquid would be lost in it—it would be of no consequence whatever;—whilst one or two million gallons of a much less impure liquid would really pollute the river more. The bulk of the polluting liquid in comparison with the bulk of the river itself I do not think is mentioned at all (in the Recommendations). There ought to be some stipulation as to the proportion which the polluting liquid should bear to the river into which it flows."

Again: "Suppose a manufacturer to be situated at the head of the stream, where it is of consequence that nothing shall go in which will in the slightest degree deteriorate that stream, and suppose he throws in a liquid which will not quite come up to these requirements,—the Act can be easily evaded by pumping a little more of the pure river water through his works, thus diluting his liquid down to the proper point and sending that into the river. But exactly the same manufacturer, fifty miles below on the stream, after the river has passed through many towns, and taken the drainage of a large district and of many manufactories, if he throws into the same river the same kind of liquid, will not be able to evade the Act in that way, because the liquid that he would throw into the river would be in some respects purer than the river itself; and he would not, therefore, be able to dilute his waste liquid with a purer water. It appears, therefore, that where the requirements of the Act ought to be carried out stringently evasion would be easy, but where it is of comparatively little consequence to carry out those requirements evasion would be impossible, because the river would be worse than the liquid which was put into it."

In reply to further questions, Mr. Crookes states: "I would therefore say that no person should send into a river water which is less pure than the water of the river at the place at which it goes in."

Again: "If the river contained 100 grs. per gallon of impurity, and I turn into it water containing 50 grs. per gallon of impurity, although that is a very impure liquid, I am doing the river good rather than harm."

This evidence points out the necessity of having, not one hard and fast line for the whole kingdom, but an "elastic test" which will gradually become more and more stringent. Surely that practical common sense, on which Englishmen were wont to pride themselves, will never allow us to punish a man for "polluting" a river when he is actually improving it!

"At Leeds," says Mr. Crookes, "a manufacturer might dip a bucket into the river, and throw it back again, and he would be in that way throwing water into the river, which would not come up to the requirements of this Act. He might simply pump the river water through his works, without doing anything with it, and he would be liable to be fined."

To do the Committee of the Lords justice, the absurdity which Mr. Crookes here points out was too great for them to defend, and accordingly in clause 4 of the amended Bill we find the following proviso:—"But no person shall be subject to the foregoing penalties if he proves, to the

satisfaction of the court before whom he is tried, that the pollution caused by him to any river or affluent thereto arises from liquid previously taken by him from such river or affluent, and does not come within the definition of polluting liquid contained in the sixth section of this Act, in a greater degree than when the same was so taken by him." The principle being thus established, we may pardon the illogicality of the expression.

Turning to the evidence of Dr. Lyon Playfair, we find that he, also, perceives the fundamental deficiency of the Bill. He suggests provisions against any discharge into a stream of matters which will raise its sum-total of impurities beyond a certain amount. He thinks it necessary "not only to guard the inlets, but to have power also to look at the stream itself, and to see that it is kept pure;" and he indicates an evil to be guarded against, viz., "the practice of flushing out drains at night, when nobody is there to watch the condition of the water."

This suggestion, like those given by Mr. Crookes, has not been adopted. Indeed, it is easy to see that there is a feeling against them. Dr. Frankland, on his second examination, actually says: "The Bill does not apply to rivers; it is not a Bill to test rivers, but to test the discharges into rivers from factories." Dr. Frankland describes the Bill correctly, and gives the very reason why it ought, as it now stands, to be rejected. His motto is evidently "the recommendations, the whole recommendations, and nothing but the recommendations." Less partial judges, however, will probably look on these same "recommendations" merely as a means to an end, and will reject them as ill-calculated for the attainment of that end. We shall return to the consideration of the remaining evidence given before the Committee, and of the amended Bill as it now stands.

ON THE ESTIMATION OF ALUMINA AND IRON IN PHOSPHATES.

By ALEXANDER ESILMAN.

HAVING had occasion to estimate alumina in various native phosphates and artificial phosphatic liquors during the last twelve months, I devised the following process, based on an old method, for the separation of iron and alumina. In its present form I do not claim for it scientific accuracy, but where commercially fair results are required in a very short space of time my past experience warrants me in offering it for trial. It is founded on the fact that, in the presence of an excess of hyposulphite of soda and acetic acid, phosphate of alumina precipitates in the tribasic form ($\text{Al}_2\text{O}_3 \cdot \text{PO}_5$) of constant composition at the boiling temperature. The precipitate is mixed with sulphur, easily washed, and on ignition the sulphur burns off, leaving pure phosphate, 122.5 parts of which are equal to 51.5 parts of alumina. Of course the presence of excess of phosphoric acid must be ensured. All our present methods involve the previous separation of the phosphoric acid, necessitating, in most cases, operating on very small quantities, and delicate working; but the one under notice is applicable whatever be the quantities of phosphoric acid, iron, lime, or magnesia, present. I have, in fact, most commonly used it for determining small quantities of alumina in presence of large proportions of phosphoric acid, where the molybdenic method proposed by Ogilvie would be almost impracticable.

One defect of it is the invariable precipitation of traces of iron with the aluminic phosphate, but the following test results, performed under very varying circumstances, show that its accuracy thereby is not materially impaired. The solution ought to be dilute and not very hot, and should contain a tolerable amount of free acid. An excess of hyposulphite of soda is added, then acetic acid in liberal excess. Ten or fifteen minutes are allowed for the complete deoxidation of the iron, and then the solution is boiled for about the same length of time. The

filtration and washing of the precipitate are done hot and rapidly, and, after drying, the latter is ignited in a porcelain crucible.

Taken.	Found.
8.76 grs. PO_5	
5.56 " Fe_2O_3	3.05 grs. Al_2O_3
3.06 " Al_2O_3	
17.52 grs. PO_5	
2.78 " Fe_2O_3	1.54 grs. Al_2O_3
1.53 " Al_2O_3	
17.52 grs. PO_5	
11.14 " Fe_2O_3	1.53 grs. Al_2O_3
1.53 " Al_2O_3	
8.76 grs. PO_5	
2.78 " Fe_2O_3	1.52 grs. Al_2O_3
1.53 " Al_2O_3	
17.52 grs. PO_5	
5.57 " Fe_2O_3	1.505 grs. Al_2O_3
1.53 " Al_2O_3	
35.04 grs. PO_5	
22.28 " Fe_2O_3	1.54 grs. Al_2O_3
1.53 " Al_2O_3	
17.52 grs. PO_5	
11.14 " Fe_2O_3	1.54 grs. Al_2O_3
1.53 " Al_2O_3	
17.52 grs. PO_5	
5.57 " Fe_2O_3	1.54 grs. Al_2O_3
1.53 " Al_2O_3	
200 " NH_4Cl	
17.52 grs. PO_5	
5.57 " Fe_2O_3	1.53 grs. Al_2O_3
1.53 " Al_2O_3	
50 " CaOCO_2	
17.52 grs. PO_5	
5.57 " Fe_2O_3	1.53 grs. Al_2O_3
1.53 " Al_2O_3	
100 " $\text{MgOSO}_3 + 7\text{H}_2\text{O}$	

The iron can be determined in the filtrate from the phosphate of alumina, after decomposition of the hyposulphite, by boiling with excess of hydrochloric acid; but I prefer employing a separate portion for that object. Having experienced an unexpected difficulty in reducing the peroxide by metallic zinc or protochloride of tin, I employ an excess of sulphide of ammonium for that purpose; the excess is decomposed by hydrochloric acid, and the sulphuretted hydrogen is easily and completely driven off by ebullition. This plan is more expeditious than when zinc is used, and more accurate than the tin method.

I have employed this process also for the rapid determination of phosphoric acid in presence of iron and alumina, especially in native phosphates of alumina, and hope to speak favourably of it some day.

ON CONDUCTION OF HEAT IN CRYSTALS.

By the numerous experiments made by De Senarmont in 1847, it was proved that heat is not always propagated, in crystals, at the same rate in all directions. Suppose a centre of heat in the middle of a crystal. If the crystal's symmetry is of the regular system, the iso-thermal surfaces are concentric spheres, but crystals of the dimetric and hexagonal systems conduct equally only in directions perpendicular to the principal axis, so that in such crystals the iso-thermal surfaces are ellipsoids of revolution round the axis; while crystals belonging to any of the remaining systems conduct unequally in all directions, so that in them the iso-thermal surfaces are ellipsoids with three unequal axes.

These results have since been largely treated from the theoretical point of view. An experimental examination

and extension of them has recently been undertaken by M. Jannettaz, who has observed and measured with the greatest care the iso-thermal surfaces in forty-four mineral species, twenty-six of which had not been previously experimented on. The particulars of this research are given in a recent number of the *Annales de Chimie et de Physique*.

M. Jannettaz employed two different methods—One is an improved form of that of De Senarmont, which, it is known, consisted in taking a very thin plate of the crystal to be examined, boring a hole in it, and coating it with wax; a heated rod was introduced into the hole; the heat was conducted through the plate, melted the wax, and thus showed the iso-thermal figure. Of course, the lateral radiation must be prevented by a screen. The improvements by M. Jannettaz are—That instead of wax he used a fat which melted more readily, that the heating arrangement was more suitable, and that for screen he employed a vessel through which flowed a constant stream of water.

In the second method, the boring of a hole in the plate was dispensed with, as it is apt to break the plate. The source of heat consisted of a small platinum ball, to which were connected the ends of two wires from a galvanic battery. The ball was put in contact with the plate; thus the heat-source was reduced to a point, and could be made as weak and as constant as might be desired. The measurement of the axes of ellipses thus obtained was effected by means of a micrometer-screw and telescope.

By these methods, M. Jannettaz obtained, for a large number of substances, numerical values of their conductivity (for heat), which, for these substances, are real characteristic constants; the form of iso-thermal ellipsoid is thus a characteristic indication of the mineral species. In the optical uni-axial crystals, the ellipsoid is sometimes flattened, sometimes drawn out in the direction of length. The latter is the case in quartz, whose ellipsoid is comparatively very long. The proportion of the axis to the radius of the equator is in this ellipse 1:312. It deserves to be noticed that this number is exactly the same as that obtained by De Senarmont, a proof of the great experimental exactness of this experimenter, who wrought with very imperfect instruments. Calc-spar shows also a lengthened ellipse, the proportion between the two axes, however, not exceeding 1:005. Antimony, on the other hand, gives a very oblate ellipse; the radius of the equator is to the axis of rotation as 1:59 to 1. Among the optical bi-axial crystals, mica gives the most distinct ellipsoid, but its appearance varies in pieces from different localities. In the clinorhombic system, gypsum is well fitted for such experiments, and gives a very distinct ellipse.

Through these measurements, which in themselves, and apart from any theory, are advantageous, as giving new specific constants for a determinate number of mineral species, M. Jannettaz believes he has been able to furnish proof that a common relation exists between the lines of greater and less conductivity and the directions of cleavage. Consider the uniaxial substances. The conductivity is less in the direction of the axis in species with basal cleavage, greater in species with prismatic cleavage. If the cleavage follows the rhombohedral surface, and if the angle which it makes with the principal axis is greater than 45° , the cleavage must be reckoned prismatic; when, on the other hand, the angle is greater than 45° , the cleavage is basal. The theoretical meaning of this law is that heat is better propagated in the direction parallel to the surface of cleavage, than in the direction at right angles to it.

This law is verified for the greater number of substances which were experimented with; a remarkable exception from it, however, is met with in emerald and calc-spar, which, from the nature of their cleavage surfaces, should belong to the class of substances with flattened ellipsoids, and which yet give an elongated ellipsoid. M. Jannettaz calls to mind that, according to M. Fizeau, two substances, on elevation of temperature, show a contraction in the direction of one of their axes.

For the other crystal systems the law is in general

proved, and particularly in the case of mica and gypsum. With both these substances, M. Jannettaz, by boring a hole through them, obtained coloured ellipses, produced from a thin layer of air which penetrates between two laminae of the substance, their axes corresponding to the thermal axes. In gypsum, which has two unequal surfaces of cleavage at right angles to the easy direction of cleavage, the long axis of the ellipse is, according to M. Jannettaz, a direction of least cohesion, arising from the union of two directions of cleavage; the production of the coloured rings, and the coincidence of their axes with those of the iso-thermal curves thus proves the law.

M. Jannettaz further states his intention to investigate several other questions connected with this subject; especially the hypothesis on crystals enunciated by Bravais, and also the result of De Senarmont's experiments with compressed glass, in which he obtained an iso-thermal ellipsoid with its small axis in the direction of compression.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

BRADFORD MEETING, 1873.

SECTION B.—CHEMICAL SCIENCE.

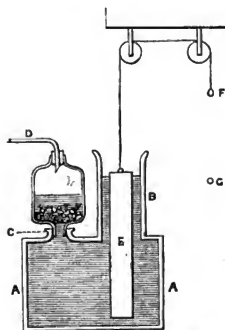
PRESIDENT, DR. W. J. RUSSELL, F.R.S.

(Continued from p. 198).

"An Improved Form of Gas Generator," by C. J. WOODWARD, B.Sc.

The author referred to various arrangements which had been devised for readily bringing into juxtaposition, or removing from each other, the material required to generate a gas, but stated he did not feel satisfied with any of them, and sought in the apparatus he had made to overcome the objections experienced. Two forms of apparatus had been made. The first, shown in section in Fig. 1, and

FIG. 1.

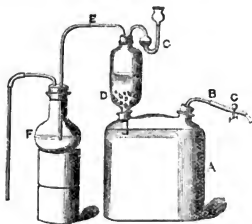


intended for large supplies of gas, consists of a circular stoneware vessel, A A, holding 3 or 4 gallons, and surmounted by a large cylindrical pipe, B. In the top of the vessel is a tubulure, C, to which is fitted a glass cylinder containing the granulated zinc or other gas-generating

material. To the opening of the upper end of the glass cylinder is attached a cork and the delivery tube, *D*. A plug, *E*, can be raised or lowered by means of a cord, which, passing over pulleys, terminates in a ring, *F*. It will readily be seen in what way the apparatus is used. As seen in the figure, the plug, *E*, is immersed in the acid, with which the stoneware jar is filled, and the liquid has risen by displacement into the glass cylindrical vessel coming in contact with the gas-generating material, when of course the evolution of gas goes on. When it is desired to stop the flow of gas, the plug, *E*, is raised, the ring, *F*, being slipped over the stud, *G*. The acid now retreats from the glass cylinder, and the gas-generating material is left dry. At any time, then, when gas is wanted, it is only necessary to release the ring, *F*, the plug, *E*, falls into the acid, the zinc, marble, &c., becomes covered, and the flow of gas begins and can easily be arrested in the manner first described.

The second form of apparatus, used when only a small supply of gas is wanted, consists of a Wolff's bottle, *A*, Fig. 2.

FIG. 2.



to one tubulure of which is fitted a cork carrying a glass tube and piece of caoutchouc piping, *n*. This pipe, *n*, can be closed by a pinch-tap, *c*. To the other tubulure of the Wolff's bottle is fitted the adapter, *D*, in which is placed the zinc, marble, or other gas-generating material. To the upper end of the adapter is fitted a cork and tube, *E*, serving for the escape of gas which is washed at *F*, and then passes on for use. To use the apparatus, the Wolff's bottle is charged with acid up to the level indicated in the figure. Then, on blowing air by the mouth by means of the tube, *n*, the pinch-tap, *c*, being open, acid is forced into the adapter, *D*, and gas at once comes off. The pinch-tap, *c*, is now closed, and the compressed air in the Wolff's bottle still keeps the acid in the adapter. When it is desired to stop the flow of gas, the pinch-tap, *c*, is opened, the compressed air escapes, and the acid in the adapter falls, leaving the gas-generating materials dry. Should the blowing of air by the mouth be deemed objectionable, an air-ball may be attached to the pipe, *n*. A safety-tube, *c*, is used, in order to prevent the liquid from the wash-bottle being drawn over on stopping the supply of gas.

Professor SCHAFARIK, from Prague, read a "Note on the Constitution of some Natural Silicates," namely, those in which chlorine and fluorine enter as essential constituents. They are few in number, but some of them important—as mica, turmaline, topaz; others interesting for their rarity, as cordialite, pyroxmalite, tencophane; or for their mode of occurrence—as sodalite. According to modern chemical views these minerals were, Dr. Schafarik said, considered as silico-fluorhydrides and silico-chlorhydrides—namely, as silicic hydracids, in which a part of hydrogen is replaced by metals, another part by a polyvalent metal only partially saturated by chlorine or fluorine. The formulae of these substances were discussed at length, and graphi-

cally constructed, showing the most simple and probable manner in which the single atoms might be arranged. The most interesting results are those found for topaz, chondrodite, and turmaline. The first is remarkable for the simplicity and beautiful symmetry of the new formulae, when compared with the unwieldy old ones. The other two mineral species are remarkable for variability of composition, which perplexed older chemists. The author shows that both are formed by the repetition of pretty simple fundamental molecules, which are linked together in any number like chains. In the case of chondrodite, the chain is open, as in fatty organic bodies; in turmaline, it is closed, as in aromatic compounds. Only in carbon compounds the carbon atoms themselves are linked together; in silicates the fundamental molecules are linked together by atoms of oxygen.—Experiments for testing these theoretical results are in progress.

Professor LAWRENCE SMITH, of America, congratulated Dr. Schafarik on having taken the true direction in the study of silicates. Hitherto they had been labouring under great difficulty in the study of these substances, from the fact that they had had to proceed on very incorrect data. Their analyses of natural silicates were very imperfect. It would be necessary to introduce into the study of silicates the same system as was employed in the study of organic chemistry. Silicon would be found to resemble, he believed, in the mineral kingdom in a great many of its properties, carbon in its relations in the organic kingdom. If the study were pursued in the direction which had been indicated, he believed a great deal of light would be thrown on silicates.

Dr. CRUM BROWN dwelt upon the importance of distinguishing between mineral structural formulae and organic formulae, and said that Dr. Schafarik had advanced in the right direction in the grouping and classification of these minerals which he had adopted.

The PRESIDENT (Professor Russell) said the section was much indebted to Dr. Schafarik for the paper he had brought before the Section, and for pointing out the relationship between organic and inorganic chemistry, and applying to the latter the modes of reasoning and thought which had been developed in the former. In the organic branch they had fortunately got compounds which they could with comparative ease experiment with. He hoped that before long they would get a great deal more power over the silicon compounds than they had. There was some reason for believing that they might be able to build up minerals and decompose them with much greater facility at all events than they could at present.

Mr. A. H. ALLEN, F.C.S., followed with a paper "On the Detection of the Adulteration of Tea." He said that, as public analyst for the borough of Sheffield, many samples of tea had been brought under his notice, chiefly by dealers themselves, in order to guard against selling tea, which, if they had been analysed by him officially, might have been condemned as adulterated. The analyses of tea up to the present time were by no means numerous; and some were so old that they might well be viewed with suspicion. The three principal constituents of tea were tannin, gum, and "woody fibre," with small quantities of some albumenoid body, theine (the active principle), colouring matters, chlorophyll, essential oils, &c. The proportions of these found by different analysts varied very much, the difference evidently depending upon the methods of determination employed. His object had been more to work out a technical method of testing teas for adulteration than to establish the actual composition of genuine tea. The estimations that had been made of tannin seemed to present the greatest variations, and in many cases they were manifestly wrong. A modification of Dr. Hassall's process, in which a volumetric solution of gelatin was used, had given him very concordant and reliable results, and had made the determination of tannin in tea an operation of a rapid and tolerably simple character. The use of a standard solution of gelatin for the determination of the strength of tannin

matters was nothing new; but he believed he had been the first to employ the process in the examination of tea. Mr. Allen then described the details of the method he employed in the estimation of tannin, stating that he had found by the process in genuine black tea of rather more than average quality 12·5 per cent of tannin, which presented a close agreement with those in the old analyses of Mulder, which he regarded as the most accurate and complete analyses of tea extant. The estimation of tannin was of the first importance; for if it reached the normal amount all question of adulteration by exhausted leaves was at an end, and foreign leaves were very unlikely to be present. The only fallacy in such a conclusion would be caused by an admixture of catechu, or sloe leaves. The next point of importance was the percentage of "woody fibre," as it was called by some analysts, and here, again, he was disposed to think that Mulder's analysis was the only accurate one. The percentage of gum, insoluble matter, and tannin in any sample of tea, considered carefully, would enable the analyst to form a very accurate opinion as to the presence or absence of exhausted leaves, &c. Analysed by the above described methods a sample of very superior black Congou tea gave the following results, which he had placed in juxtaposition with the numbers obtained after some of the same sample had been infused in the usual manner in the teapot (the exhaustion was not carried to excess, no second quantity of tea being used), and the leaves re-dried:—

	Original Tea.	Exhausted Tea.
Moisture	9·2	11·1
Insoluble matter	58·7	87·5
Gum	10·5	3·8
Tannin (by gelatin)	15·2	3·3

From this it would be seen that infusion in the teapot resulted in the increase of the insoluble matter by nearly 30 per cent, while the gum and tannin were much reduced in amount. Generally the exhausted leaves were re-dried and made up with gum, which gave them a peculiar glossy appearance, and was detected by excess on analysis. From a table which he had prepared of thirteen different analyses, he gave several instances of adulteration. In one case he was attracted by a table in a window, "Try our fine rough, flavoured, thick, sappy, Moning Congou at 2s. a lb." The specimen, when examined, was found to contain catechu, starch, magnesia, metallic iron, graphite, sand, &c. He had also found sloe leaves presenting a close resemblance to green tea in every respect. An inspection of the specimens analysed showed that genuine green teas were richer in tannin than black teas in about the proportion of two to three. This was no doubt due to the partial oxidation and destruction of the tannin during the process of fermentation to which black tea is subjected in the process of manufacture. Whether the acknowledged superior strength of green tea was due to the larger percentage of tannin present in it, he was not prepared to say. The determination of theine he had made did not account for the difference, and most analysts had found more theine in black than in green tea. The infusion of green tea was not nearly so strong in colour as that of black tea, though it was half as strong again in tannin, so that the depth of colour could not be regarded as a proof of strength, though generally so considered. If a solution of carbonate of sodium be added to a weak infusion of tea (strained away from the leaves) a considerable darkening was observed, though certainly the infusion could become no stronger. Thoroughly extracted tea leaves yield a brown liquid when treated with carbonate of sodium solution. These facts quite explained why careful housewives had a fancy for putting soda in the teapot, the infusion becoming sensibly darker by the addition, to say nothing of the extra colouring matter from the leaves. Apart from its softening effect on the water (the advantage of which he thought was doubtful), there could be no good reason for its addition.

In the methods he had used for detecting facing and colouring there was not much that was new. On treating the tea with warm water the colours and facings came off, and on straining off the leaves and leaving the liquid at rest, they gradually settled to the bottom. If prussian blue or indigo were present the sediment generally had a bluish or greenish colour, and the tests for these pigments must be tried accordingly. Magnesia was often present both in the free state and as insoluble silicate. This latter facing he had found on several occasions lately on green teas of peculiarly smooth appearance and slippery feel. It was detected by heating the sediment with hot hydrochloric acid, and then with solution of caustic soda. The residue was ignited and fused with alkaline carbonate, the first product dissolved in acid, evaporated to dryness, re-dissolved in weak acid, the solution treated with ammonia and oxalate of ammonia, the precipitate filtered off, and the clear liquid tested in magnesium, in the usual way, by phosphate of sodium, when an abundant precipitate was obtained, proving the presence of magnesium as silicate.

The President observed that the Adulteration Act would no doubt have the effect of increasing the number of chemists in England, and such questions as that of the adulteration of tea would by day become more important. He wished that a great many of the analysts appointed under the Act would follow Mr. Allen's very good example, and bring to the Association the results of their experiments. Mr. Allen had worked out the case of tea very thoroughly, and at the same time he had shown some of the pitfalls into which chemists were pretty sure to tumble sooner or later. There was a great deal to be done in these testings for adulteration, and to make the Act in any way useful the testings must be carried out in a most thorough and accurate way. He only wished all public analysts were as careful as Mr. Allen.

Mr. CAIL asked Mr. Allen whether he had made any analysis of the ash of the tea plant?

Mr. ALLEN said he had not; but that the ash should not exceed more than 5 per cent. Many of the things used for adulterating tea had more.

Mr. CAIL said he had made analyses, and found a good deal of manganese in the tea. He desired to know whether that was used for colouring, or whether it was got out of the soil by the growth of the plant. It might be used as a colouring in preference to prussian blue.

Mr. ALLEN said that manganese was understood to be one of the constituents of the ash of the tea; and added that he thought foreign leaves might be more easily detected by skeletonising the leaves than by simply putting them under the microscope.

"Specific Gravity Bottle for Liquids Spontaneously Inflamable in contact with Air," by ALFRED TRIBE.

The bottle usually employed for sp. gr. determinations of liquids consists, essentially, of a light flask provided with a perforated stopper. By means of this arrangement sufficiently accurate results can be readily obtained when the liquid is not very volatile or violently acted upon by the air.

To meet the requirements of volatile liquids, Regnault employed a flask having a solid in place of a perforated stopper, and a neck somewhat longer and narrower than the old form. The liquid is poured up to a mark made on the neck, and the water value being known, the specific gravity is found. It is obvious that by this method loss by evaporation or expansion during weighing is prevented. For liquids, however, which are violently decomposed by the air, especially when with formation of thick clouds, e.g., the zinc compounds of the lower members of the alcohol radicals, this plan, from the practical impossibility of adjusting with accuracy to the given work and the required temperature, is not so satisfactory as might be desired.

To meet liquids of this class I have devised the following improvement upon Regnault's bottle:—The neck is of as even bore as possible, and divided into as many equal

parts as can be conveniently read. The bottle (made by Cetti) actually employed, which answered perfectly, has a capacity of 2.6 c.c., the neck being about 3 m.m. internal diameter and 13 long, divided into 4 m.m. Just beyond the graduations the neck is widened somewhat for the stopper and for pouring in the liquid.



When once the water values have been determined for each division on the neck, it will be seen that it is only necessary to fill the bottle so that the surface of the liquid shall fall within the range of the graduations. Another advantage is that the contents can be raised or lowered to the normal temperature, and the volume read off, without addition or subtraction of liquid.

The 4 m.m. divisions of water weighed 5 milligrams. As it is easy to read to a half of one of these divisions, and, with care, to a quarter, the error need not be more than the weight of liquid equal to one or two milligrams of water. A pipette with a capillary tube will be found convenient for introducing the liquid, and of course the operation of filling liquids of the character of zinc-ethyl should be done in absence, as far as possible, of free oxygen.

CORRESPONDENCE.

COPPER IN FEATHERS.

To the Editor of the Chemical News.

SIR,—In connection with a letter published in your last number, the following observations, made three or four years ago, may interest some of your readers:—

We kept at that time two Australian love-birds of the variety called *Melospittacus undulatus*, small paroquets, with grass-green plumage. The birds were often allowed to fly about the room, and I observed that they preferred brass fittings to any other perch, and that they used to sit and peck at the brass-work. On asking an Australian friend as to the habits of these birds, he told me that they abound chiefly in the districts where copper is found.

These facts, and the recollection of Mr. Church's discovery of copper in the red feathers of the turaco, led me to examine some of the feathers which these birds had let fall in flying about.

I collected seven or eight of the feathers, burnt them, and extracted the residual ash with nitric acid. On adding solution of potassium ferrocyanide to the filtrate, a distinct precipitate of the colour of copper ferrocyanide formed.

The cage in which the birds lived was of iron, not brass, wire; and as we had already had them more than a year, and they were in the habit of frequently washing themselves, it seems certain that the copper found in the ash existed naturally in the feathers.

Probably a green pigment, analogous to Mr. Church's turacin, of which copper is a constituent element, may be extracted from these feathers. My attention having been recalled to the subject by your correspondent's letter, I propose to examine it further.—I am, &c.,

SYDNEY LUPTON."

Christ Church, Oxford,
October 18th, 1873.

MANUFACTURE OF GAS.

To the Editor of the Chemical News.

SIR,—I am manufacturing gas upon my patent system of carbonising, which is done by passing the hydrocarbons

over incandescent coke, therefore making more pitch than tar. The gas and pitch come into contact with water as they leave the retort; the result is that a green and a yellow-green colour is washed out of the pitch (which I take to be anthracene), the colour varying according to the quality of coal carbonised, when, after long exposure to light, it becomes black (oxidised), which resembles the sediment of black ink. Would you or any subscriber say if it is worth collecting?—I am, &c.,

A. MALAM.

Dumfries, Oct. 21, 1873.

NEW VOLUMETRIC ASSAY OF IRON.

To the Editor of the Chemical News.

SIR,—Many chemists will sympathise with Captain Ross in his protest against the shortcomings of discoverers (?) who publish as new facts processes so long since made public; but, with reference to the special grievance of the gallant captain, if he takes the trouble to refer to his letter to the CHEMICAL NEWS, vol. xvii., p. 23, he will see that, although he therein suggested the idea that ferric sulphocyanide might be used as an indicator in the well-known process of determining the combined acid in a metallic salt (such as a per-salt of iron) by means of a standard alkaline solution, he yet had not at that time carried out his idea to a practical result; and, moreover, that he took no account of the fact that all free acid must be absent. Now M. Charpentier, whom Captain Ross accuses of injustice, has at any rate these merits—that he made the process work (more or less accurately), and that he took cognisance of that latter very material circumstance.

In the letter referred to, Captain Ross solicited the opinion of chemists on his ideal process; in answer to his request, I pointed out—Firstly, that the process, as suggested by him, would give inaccurate results, from the necessary presence of free acid; secondly, that it is impossible to estimate accurately the amount of free acid in such in solution by the ordinary volumetric processes; and, thirdly, that the decolorisation of ferric sulphocyanide (and also of ferric ferrocyanide) is a less sharp terminal reaction than the change of colour in certain vegetable colouring matters. It may therefore be inferred (as is proved by actual experiment) that the Ross-Charpentier process is less convenient in practice than those in ordinary use.—I am, &c.,

C. R. A. WRIGHT, D.Sc.

Chemical Laboratory, St. Mary's Hospital,
Paddington, W., Oct. 22, 1873.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopaedic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgement. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, September 22, 1873.

On Corallin.—M. Commaille.—Corallin is obtained at temperatures which may vary from 115° to 150°, at the latter temperature the yield is more considerable and the operation more rapid. The quantity of oxalic acid recommended by authors is far too high. Corallin does not give definite metallic salts, but merely coloured lakes. Yellow corallin is not an acid, for it does not expel carbonic acid from its combinations, and does not form

definite compounds with bases. The name of rosolic acid applied to it is quite incorrect. Red corallin does not contain nitrogen, and cannot therefore be an amide of the red variety.

Thermal Researches on the Condensation of Gases by Solid Bodies (Continued): Absorption of Hydrogen by Platinum Black.—M. Favre.—When hydrogen is brought in successive portions into contact with platinum-black up to saturation, the heat liberated is not constant for equal weights of gas absorbed, as in the case with palladium. Thus, in condensation of ordinary gaseous hydrogen by platinum, the first experiment gave 23,075 calories; the fourth, 13,528. Hydrogen condensed by palladium seems to be distributed in a uniform way throughout the metal, forming with it a true alloy; whereas hydrogen condensed by platinum-black is apparently distributed like carbonic acid or ammonia fixed by wood-charcoal, i.e., forming layers less and less dense, from the surface of the metal inwards. It is a phenomenon of *capillary affinity*. It is likely that, as in the case of sulphurous acid and protoxide of nitrogen condensed by wood-charcoal, the heat liberated exceeds the latent heat of liquefaction of the gas. The author next considers what occurs in the electrolysis of sulphuric acid, e.g., with a couple of zinc and palladium (Expt. I.), and one of zinc and palladium (Expt. II.). In the former case the gas is fixed in the active state by the palladium at the moment of leaving, the liquid and the 9000 calories or so liberated in fixation are the thermic expression of the condensation; in which the gas has passed to the solid state without ceasing on that account to be active. In the case of zinc and platinum, however (Expt. II.), the active hydrogen, issuing in the state of a true explosive substance, undergoes an allotropic modification, and is transformed into ordinary and liquid hydrogen. In this transformation, notwithstanding absorption of heat through passage of the hydrogen, thus formed from the liquid to the gaseous state, the calorimeter shows about 4600 calories. Recurring to the condensation of ordinary gaseous hydrogen by platinum, it appears that the hydrogen active and liquid (i.e., existing in the liquid compound from which it is separated), which liberates about 4600 calories in passing to the ordinary gaseous state, and about 20,700 calories in being fixed by platinum-black after this transformation, would liberate about 25,300 calories if it did not undergo a transformation before its condensation by platinum, at the surface of which it ceased to be in the active state. Another conclusion is that the active and liquid hydrogen, which liberates only about 9000 calories, in being fixed directly by the palladium (Expt. I.) must necessarily, remaining active, constitute with this metal a true explosive alloy, susceptible of liberating about 14,000 calories by decomposition into palladium and ordinary hydrogen, supposed in the solid state. From these and other thermal phenomena studied it seems well established that the hydrogen entering into the formation of acids is in the active state, and M. Favre thinks the same may be said of the hydrogen in water. The thermal phenomenon of the formation of water, and that of its decomposition are not, he remarks, so simple as might at first be supposed. Starting with the constituents of water, taken in the ordinary state, the quantity of heat shown by the calorimeter is the algebraic sum of the numbers furnished by the following phenomena:—(1) Passage of hydrogen and of oxygen, ordinary and gaseous, to the active and also gaseous state; (2) combination of these elements thus modified; (3) passage of water vapour to the liquid state.

Some Peculiarities Relative to the Winged Form of Phylloxera, as Regards Propagation of the Insect.—M. Cornu.—The author arrives at the conclusion that the winged individuals of *Phylloxera vastatrix* are much more numerous than has hitherto been thought: that they use their long and fragile wings (as the *Phylloxera quercus* also does), and with the aid of wind may be carried

a considerable distance. The observation has an important bearing on the choice of remedies.

The Most Suitable Time to Apply Submersion to Vines Tainted by Phylloxera.—M. Faucon.—The author states objections to submersion in either spring or summer.

Integration of Equation with Partial Derivatives for Isostatic Cylinders Produced within a Mass Subjected to Strong Pressures.—M. Boussinesq.

Movement of an Elastic Wire, one Extremity of which is Animated by a Vibratory Movement.—Second note by M. Mercadier.—An eighth law is added for the normal vibratory state, viz., that for different wires of the same section the normal nodal distances are proportional to the fourth roots of the quotients of the coefficients of elasticity divided by the density. Coming to the *abnormal* vibratory state, the author describes the phenomena obtained on shortening the wire, millimetre by millimetre, beginning with the normal state. The vibrations become curvilinear, and this amplitude increases, while that of the diapason diminishes, and may even become *nil*. On further shortening the same phenomena are reproduced, but in reverse order: till the normal state recurs, the vibrations of the wire becoming plane. The author constructed two curves, having for abscissæ the lengths of wire, and for ordinates of the one the amplitudes of the free extremity of the wire; for those of the other the amplitudes of the diapason. The following laws are deduced:—(9) The lengths of wire for which the amplitude of the free end is minimum and equal to that of the diapason are, commencing with the shortest, in arithmetical progression, the ratio of which is precisely the normal nodal distance of the wire. (10) The lengths of wire corresponding to the points of complete extinction of the diapason are also, commencing with the shortest, in this arithmetical progression. (11) Each of the points corresponding to minimum amplitude of the wire is very nearly at equal distance from the two points of extinction of the diapason, between which it is comprised. The foregoing research has a practical bearing on the question, viz., what length to give a style fixed to the end of a vibrating body (tuning-fork, e.g.), so as to have the greatest amplitude possible without altering the vibratory period of the diapason. The abnormal vibratory state must evidently be avoided.

Proportion of Carbonic Acid in Atmospheric Air; Variation of this Proportion with the Altitude.—M. Truchot.—The observations were made almost daily during July and August at Clermont Ferrand. The method consisted in passing the air into baryta water previously titrated, then allowing deposition of the carbonate formed, then titrating anew the limpid supernatant liquor, a known quantity of which was separated with a pipette. The numbers obtained show—(1) That the proportion of CO_2 is a little greater during the night than during the day (as was previously observed by De Saussure and Boussingault). (2) That the proportion is not sensibly higher in the town than in the country. (3) That in the neighbourhood of plants with green leaves in full vegetation the proportion of CO_2 varies considerably according as these green parts are illuminated by the sun, or are in shade, or quite in darkness; this agrees with a well-known fact in vegetable physiology. (4) That, on a general average, the proportion is 4.09 vols. per 10,000 vols. of air, which closely agrees with the numbers obtained by De Saussure (4.15); Thenard and Boussingault (4); and Verver (4.2); but is much higher than those of German observers, Schulze (2.9), and Henneberg (3.2) at Rostock and Weende. To ascertain the influence of height, determinations were made simultaneously at Clermont Ferrand, 395 metres above the sea; at the top of Puy du Dôme, 1446 metres; and at the top of Lancy, 1884 metres. The respective numbers were 3.13 vols. (per 10,000 of air), 2.03, and 1.72; showing a marked decrease with the height. This is not surprising when one

considers that, on the one hand, it is at the surface that CO_2 is produced; and, on the other, that it is considerably heavier than air.

Observation, on the Night of Sept. 20, 1873, of a Bolide which left behind an Incandescent Train.—M. Chapelas.—The train, observed through a telescope, presented a remarkable undulation. It continued ten minutes after the complete disappearance of the meteor, having the same direction. Then, becoming more compact and brilliant, it suddenly took the direction of the wind, N.W. to S.E. (being originally N.N.W. to S.S.E.). A very thick mist covered Paris immediately afterwards.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, Tome xxxii., No. 5, October 2, 1873.

Transparent Paper.—The paper is soaked in the following composition:—Linseed oil, boiled and bleached, 20 kilos.; lead turnings, 1 kilo.; oxide of zinc, 5 kilos.; Venice turpentine, 1 kilo. The whole is mixed and boiled for eight hours; after cooling it is stirred, and the following ingredients added:—White copal, 5 kilos.; and sandarac, 1 kilo.

Poisonous Nature of Cobalt.—According to Siegen the nitrate and chloride of cobalt rank among poisons. 1 centigram of either of these proved fatal to a frog in half-an-hour; 3 decigrams killed a strong rabbit in three hours. The poison acts directly upon the muscles of the heart.

Indelible Ink.—Elsner takes equal parts of coppers and vermilion, powders, sifts, and grinds with linseed oil; the whole is finally pressed through linen. The thick paste can be applied for writing and for printing on wool or calico. It resists bleaching.

Revue Scientifique de la France et de l'Etranger,
September 12, 1873.

Meeting of the French Association for the Advancement of Science at Lyon.—*Chemical Section*, August 25.—Ch. Blondeau—proceeding on the theoretic idea that sugar introduced into the animal organism can be transformed into alcohol and carbonic acid by the action of the blood globules playing the part of a ferment—brought blood and glucose into contact and obtained alcohol, the nature of which he verified by taste, smell, and by its reaction with the permanganate of potassa. Hence he infers that there occur in the system phenomena of fermentation calculated to split up sugar into alcohol and carbonic acid. The fermentation of sugar under the influence of blood has been confirmed by M. Béchamp.

M. Balard remarked that the characteristics adduced by M. Blondeau were insufficient to prove the presence of alcohol.

M. Wurtz pointed out that the procedure of Gay-Lussac (repeated distillation over carbonate of potassa) rendered it practicable to isolate very small quantities of alcohol, and that the presence of this body could be demonstrated by transforming it into iodide of ethyl.

M. Friedel gave a summary of the researches which he had carried on in concert with M. Silva on pinacol, $\text{C}_6\text{H}_{14}\text{O}_2$, obtained by the hydrogenation of acetone. He explained the most advantageous method of preparing pinacol, and described the action of perchloride of phosphorus upon this compound. Perchloride of phosphorus acts upon pinacol, a tertiary glycol, not by forming the normal chloride $\text{C}_6\text{H}_{13}\text{Cl}_2$, but a chloride, $\text{C}_6\text{H}_{11}\text{Cl}$, representing the normal chloride, less a molecule of hydrochloric acid. At the same time the perchloride exerts a chlorinising action upon $\text{C}_6\text{H}_{11}\text{Cl}$, producing in the same reaction a crystalline body, $\text{C}_6\text{H}_{10}\text{Cl}_2$. These two chlorides, $\text{C}_6\text{H}_{11}\text{Cl}$ and $\text{C}_6\text{H}_{10}\text{Cl}_2$, are not saturated, as they can fix 2 atoms of bromine yielding respectively $\text{C}_6\text{H}_{11}\text{ClBr}_2$ and $\text{C}_6\text{H}_{10}\text{Cl}_2\text{Br}_2$. To obtain the normal chloride, $\text{C}_6\text{H}_{13}\text{Cl}_2$, it is necessary to have recourse to the less violent action of oxychloride of phosphorus upon pinacol, or to that of

the perchloride of phosphorus upon pinacol, $\text{C}_6\text{H}_{14}\text{O}_2$. The chloride, $\text{C}_6\text{H}_{13}\text{Cl}_2$, crystallises and is identical with the bichlorated di-isopropyl described by M. Silva.

MM. Friedel and Silva have also studied the action of nascent hydrogen, and that of oxidising agents upon pinacol. By hydrogenation two compounds are obtained; a crystallised body resulting from the fixation of 2 atoms of hydrogen upon 2 molecules of pinacol, and containing $\text{C}_6\text{H}_{16}\text{O}_2$, and pinacolic alcohol, $\text{C}_6\text{H}_{14}\text{O}$. Of this alcohol the authors have prepared the iodide, the acetate, and the benzoate. On oxidation it reproduces the pinacol. The oxidation of pinacolone gives rise to pivalic acid, $\text{C}_5\text{H}_{10}\text{O}_2$, isomeric with valeric acid, crystalline, and fusible at 30° . This acid appears identical with the trimethyl-acetic acid of Boutlerow.

M. D. Tomasi has been occupied with the action of the chloride of chloracetyl upon various primary monamines of the aromatic series. He has obtained chloracetanilide, $\text{C}_6\text{H}_5\text{NHC}_2\text{H}_3\text{ClO}$, chloracetyl-toluidine, and chloracetyl-naphthylamine. He described also chloracetyl-urea.

Ch. Risler gave a summary of the most recent analytical applications of the hydrosulphite of soda.

MM. Schützenberger and Risler have applied the reducing power of this salt to determine oxygen dissolved in water and in blood. M. Risler described the apparatus employed in these determinations.

MM. Schützenberger and Quinquand have applied the same reaction to study the respiration of submerged aquatic vegetation, and to ascertain the action of beer-yeast upon dissolved oxygen.

SESSION OF AUGUST 27th.

M. A. Henninger has studied the reducing action of formic acid upon alcohols of different atomicities.

M. Wurtz, having obtained the normal density of the perchloride of phosphorus by allowing it to diffuse in one of its products of dissociation, the protochloride of phosphorus, attempted to find the normal density of the hydrochlorate of ammonia by an analogous procedure. He caused this salt to diffuse in hydrochloric gas, but sal-ammoniac volatilises at a very elevated temperature, at which it becomes entirely dissociated in spite of the presence of hydrochloric gas. The density yielded by experiment in these conditions corresponds to four volumes of vapour, that is, to a complete dissociation of the salt into hydrochloric acid and into ammonia. M. Wurtz called attention to the generality of the phenomena known as dissociation.

M. G. Loremoine described the transformation of white phosphorus into the red state, and the curves of dissociation of hydriodic acid.

M. Ribau explained his interesting researches on the terebic carbides, and the isomerism of their hydrochlorates.

M. Gourdon, of Lyon, described some novel facts which he had observed in the action of acids upon zinc covered with certain metals. Zinc plunged into dilute solutions of sulphuric, hydrochloric, and acetic acids is attacked only at the points where other metals are present. The metals which produce this phenomenon with most intensity are cobalt, platinum, nickel, and iron. Ammoniacal chloride of cobalt renders it possible to perforate zinc with water containing only 1-10,000th part of sulphuric acid. M. Gourdon applies these results to various procedures for engraving. By writing directly upon zinc with different metallic inks, making use of the most active, containing salts of cobalt for the blackest parts, and passing it then into acidulated water, an engraved plate is obtained. To reproduce leaves or plants they are soaked in solutions of metallic salts, and applied to the zinc, which is then treated with weak acid. The author has discovered a new kind of heliographic engraving by transferring the silver from an ordinary photographic proof upon the zinc, which can be attacked by the acids in the parts where the silver has been deposited.

M. Vidal described his process of polychromic photography.

M. Vignon has prepared mannin by mixing mannit with half its weight of concentrated sulphuric acid, and keeping the mixture at 125° for two hours. Mannin turns the plane of polarisation to the right, and does not yields mannit even on boiling with baryta water for an hour. If mannit is heated to 280° with a little water a body is obtained which appears to be mannin, but which turns the plane of polarisation to the left, and yields mannit on boiling with water.

M. Vignon has likewise examined the action of sodium amalgam upon ammoniacal salts, and determined the conditions under which the greatest quantity of the ammoniuret of mercury is produced. The sodium amalgams are less efficacious the more sodium they contain. With nitrate of ammonium sodium amalgam does not yield an ammonium amalgam. There is a brisk effervescence due to the escape of nitrogen. In fact if nitrate of potassa is treated with sodium amalgam, nitrogen is evolved, and nitrite of potassium formed. As sodium amalgam does not act upon the compound ammonias, M. Vignon proposes the use of this amalgam to detect the presence of ordinary ammoniacal salts in the salts of the compound ammonias.

M. Gruner has been engaged with measuring the quantity of heat needful to effect the fusion of cast-iron slags, dross, and steel, in order to compare the heat produced in blast-furnaces with the heat utilised. He finds that cast-iron melts at from 1579° to 1462°. Bessemer steel melts at 1600°.

SESSION OF AUGUST 28TH.

M. Masson, of Lyon, exhibited various specimens of veterinary medicines.

M. Perret exhibited hydrochlorate of trimethylamin obtained from herring-brine, anthracen, valerianate of quinine obtained by the double decomposition of sulphate of quinine and valerianate of baryta, slightly basic.

M. Jacquemin's paper "On the Analytic and Toxicological Detection of Phenic Acid" was read. The reaction upon which the author's method depends is the blue colouration produced by hypochlorite of soda in a mixture of phenol and anilin. It was remarked by several members that anilin alone gives a blue reaction with alkaline hypochlorites.

M. Macé sent in a memoir on the existence of germ ferments in living organisms. He maintains that germ ferments may exist for a time in the organism in a passive state.

No. 13.

Photometry of Absorption Spectra, and its Application to Quantitative Chemical Analysis.—Ch. Vicordt. —This paper, translated from the German, is not suited for abstraction.

No. 14.

This number contain no chemical matter.

Reimann's *Färber Zeitung*, No. 33, 1873.

This number contains receipts for green, crimson, and yellow on sloddy, and ponceau on cloth, and for blue and brown on silk.

In reviewing the Vienna Exhibition, the beautiful sugar-of-lead and yellow prussiate in the Austrian department are spoken of as far surpassing any similar articles from the German Empire. Joseph Nowak, of Prague, exhibits starch in all preparations, flavin, and lake colours, especially a cochineal ponceau, and a fustic lake ready for direct application in calico- and woollen-printing. It is remarkable that Austria has not a single manufacture of anilin and anilin colours; this is ascribed, in part, to the fact that lignite is almost exclusively used in the Austrian gas-works, the tar being consequently very poor in benzol. The Austrian printed calicos, especially those of Franz Leitenberger, of Cosmanos, deserve commendation, as also the turkey reds. There is a fine display of gauze

printed with woollen dust; the designs are printed upon the goods in starch-paste mixed with gum, and the dust of coloured wool applied, which adheres only to the moist parts; rich and novel effects are produced by this style, which is much admired for ball costumes.

The editor gives also receipts for black and brown on plush; for a salmon on wool and woollen yarns; for a light scarlet on the same materials, remarkable for the total absence of oxalic acid, the wares being, to 100 lbs. of wool—3 lbs. of tin crystals, 3 lbs. of tin-composition (perchloride), 3 lbs. of tartar, and $\frac{1}{2}$ lb. of cochineal. Further is a medium blue-green on woollen cloth, and three receipts for printing greens on calico.

No. 34, 1873.

An extract of sumac is now in great request. It is prepared by exhausting the ware with water, and careful concentration in a steam-bath, generally with the aid of the vacuum-pump. It is sold as a thick syrup, of a pure astringent taste, without the slightest acidity. This permanence is ascribed to the high concentration which appears to hinder the transformation into gallic acid.

In the French department we find a splendid assortment of anilin colours. Noteworthy is a corallin, said to be able to bear clearing (*avivage*) at a boiling temperature. The dye extracts of Coët, and the natural alizarin and purpurin, orcin and orcein, of Meissonier also deserve mention.

The instructions for dyeing and finishing plush are continued. There is a receipt for Bordeaux—i.e., cherry-brown on wool, and a porcelain-white on the same material.

The announcement appears of an international exhibition of textile manufactures, to take place in Berlin.

For a black on cotton-wool, the goods are to be boiled for three hours in logwood liquor (30 lbs. to 100 lbs. of cotton); worked in a cold bath of 15 lbs. of chromate of potash and 10 lbs. of blue vitriol for an hour; put back into the old extract bath, cooled down to 60° R. (= 167° F.), in which 10 lbs. of soda-ash have been dissolved; worked for two hours, and saddened with 10 lbs. of copperas. A Dr. Kienmeyer recommends the use of acetate of iron, made by the direct action of crude pyroligneous acid upon scrap-iron (general in this country), in preference to the kind made by double decomposition of copperas and sugar-of-lead. He points out the (well-known) value of the tarry impurities in preventing peroxidation of the iron. He explains the addition of arsenious acid to black-liquor as calculated to exert a similar action. He concludes with the strange statement that acetate of iron at 20° Baumé is chiefly used in *woollen* dye-works for dyeing a black, the tarry matters co-operating as a black-dyeing ingredient!

Annalen der Chemie und Pharmacie, band clixviii., heft 2 and 3 (Neue Reihe, band xcii., heft 2 and 3), August 30, 1873.

On Ethyl- and Diethyl-Allylamin.—Albert Rinne.—The author finds that diethyl-allylamin is isomeric with the ethyl-piperidin of Cahours, its boiling-point being 25° lower.

Examination of the Isomeric Cresols, with reference to their Occurrence in Coal-Tar.—M. S. Southworth.—The author has examined meta-, ortho-, and para-cresol.

Sorbic Acid.—E. Kachel and R. Fittig.—(Second treatise).—An examination of sorbic tetrabromide, with its sodium, potassium, calcium, and zinc salts; the decomposition of the above salts by the action of heat; their behaviour with hydrogen; sorbic dibromide or dibrom-hydrosorbic acid and hydrosorbic acid.

Processes in the Interior of the Non-Luminous Flame of the Bunsen Burner.—R. Blochman.—A lengthy and exhaustive paper, illustrated with three plates, and occupying more than sixty closely-printed pages.

MISCELLANEOUS.

Public Analysts.—Mr. Wentworth L. Scott has lately been appointed Public Analyst, under the Adulteration of Food Act, for Derbyshire and Stafford, by the Justices for these counties respectively. Mr. Charles H. Piesse has been elected to the office of Public Analyst for the Strand district.

Metropolitan Gas.—Dr. Letheby, the chief gas-examiner appointed by the Board of Trade, has recently reported to the Corporation of London and the Metropolitan Board of Works of the quality of the gas supplied by certain of the Gas Companies during the last three months, and from this it appears that the average illuminating power of the common gas has been as follows:—Chartered Gas: at Beckton, 17.46 standard sperm candles; at Cannon Street, 16.58 candles; at Friendly Place, Mile End, 17.29 candles. Imperial Gas: at Carlyle Square, 17.51 candles; at Camden Street, 16.78 candles; at Graham Road, 16.51 candles. South Metropolitan Gas: at Hill Street, Peckham, 17.15 candles. The canal gas of the Chartered Company has averaged 21.54 candles at Millbank, and 21.16 candles at Ladbroke Grove. These results show that the illuminating power of the gas has been fully equal to the requirements of the Acts of Parliament. With respect to impurity, Dr. Letheby reports that the gas at all the testing-places has contained less ammonia than is prescribed by the referees, viz., 2.5 grains per 100 cubic feet of gas. The Chartered gas has been constantly free from sulphuretted hydrogen, but that of the Imperial Company and South Metropolitan Company has at times been charged with sulphuretted hydrogen, arising from accidental causes, created by the new regulations concerning the proportion of sulphur permitted to be present in the gas. The average amounts of this impurity has been as follows:—Chartered Gas: at Beckton, 12.44 grains per 100 cubic feet; at Cannon Street, in the City, 12.02 grains; at Friendly Place, Mile End, 13.77 grains; at Millbank, Westminster, 19.27 grains; at Ladbroke Grove, Notting Hill, 17.78 grains. The Imperial Gas: at Carlyle Square, Chelsea, 18.09 grains; at Camden Street, Camden Town, 12.27 grains; at Graham Road, Dalston, 17.60 grains. And the South Metropolitan Gas, 22.87 grains. Dr. Letheby remarks that the proportion of sulphur in the South Metropolitan gas compared with that in the Chartered gas indicates a want of skill in the conduct of the operations, which no doubt will be improved.

NOTES AND QUERIES.

Dyeing Black Kid.—Could any of your readers inform me how kid is dyed black, or where I might be able to get the information?—**SUBSCRIBER.**

Detection of Petroleum Spirit in Coal Naphtha.—Will any of our readers kindly inform me of a reliable method for the detection of petroleum spirit when present in coal naphtha? It being often used as an adulterant also, how can I distinguish between crude Scotch and English naphtha?—**E. J. D.**

Separation of Iron from Nickel and Cobalt.—Fresenius, in his "Quantitative Analysis," gives for the separation of iron from nickel and cobalt and strong bases, a method which depends upon adding a solution of ammonia carbonate to the solution until the solution has lost its transparency. Will you kindly inform me, through the medium of your valuable paper, whether the carbonate used in this method is a solution of the ordinary solid carbonate, or a solution of the solid made neutral by ammonia?—**A. BEGGINER.**

Notes on the Utilisation of Sewage.—(From the "Report of the Main Drainage Committee for 1864," vol. 45).
1215. (To Sir Charles Fox.) That would be 132,727,272 tons per annum would it not?—**Yes.**

(Mr. Smith.) The sewage proper will take 4,202 horse-power to lift it 180 feet, that is, allowing for friction; and for dealing with the gross sewage it will take 19,096 horse-power.

(Sir Charles Fox.) That is, Watt's horse-power of 33,000 lbs. lifted.

1231. (Sir Charles Fox.) We have taken 180 feet as the average height to which the whole sewage of London will have to be lifted; that is, of course, too much for some areas, and too little for others, but on an average we think it will meet the whole case.

1207. (To Mr. Smith.) You propose to construct, as liters, from 500 to 1000 acres of oyster beds through which you will pass the sewage after it has left the other lands, in order fully to deprive it of all deleterious and injurious matters; are you uncertain as to the size of these oyster beds?—The London Waterworks allow 2 square yards for a gallon of water per minute, and I think we have more than 10 square yards per minute.

1209. (Sir Charles Fox.) The water that is used for the purposes of irrigation and fertilisation must in a great measure find its way back again into the river; but our object is, to rid it of all its fertilising properties, and after it has been applied to the land to make use of it in the growth of osiers; that is a very profitable operation, and it will take the last fertilising properties out of the water.

1210. (To Mr. Smith.) Has the osier any peculiar property of deodorising the water?—We always find osiers precipitating a great depth in search of water, and, if you have a sewer or a drain, it is almost certain to be filled with roots of willows or osiers.

1211. (To the same.) Then it is not peculiarly valuable as a deodorant?—Its peculiar value is that it grows in water; the silt would be equally as good as the osier.

(Sir Charles Fox.) The osier is of unusually rapid growth, and consequently requires more fertilisation.

1216. (To Mr. Smith.) In frost the sewage does not sink into the land, does it?—I think it will. The temperature of the sewage, according to Mr. Mechi, is quite high enough to thaw a hard frost sufficiently to soften it.

(Sir Charles Fox.) I thought that the sewage would find its way back to the Thames, but Mr. Mechi thinks not, and Mr. Smith agrees with him.

1242. (To Sir Charles Fox.) Then would not the fertilising matter of the sewage be in great dilution?—In ordinary storm-water, the fertilising quality of the water is rather greater than under ordinary circumstances, from the fact of the water washing out the deposit from the bottom of the sewers. It so happens that the first portion of the storm-water washes out the greater portion of accumulation in the sewers, and that would pass away on to the lands, and it would only be the latter portions of the storm-water, which are very free from injurious matter, which would go into the River Thames, and that only during some of the summer storms.

1249. (To Mr. Smith.) Could you supply the farmers by measure through the pipes?—Yes, certainly, or by meter.

1250. (To the same.) Do you propose to do it through a gauge?—Yes.

1251. (To Sir Charles Fox.) Would not the gauge stop the flow of the sediment to a considerable extent?—No, there are plenty of waterworks that would let any sewage pass through without the slightest difficulty; in fact, perhaps one of the best is simply a cross heavily hung, which the fluid turns round in passing through, and regulates the quantity with considerable nicety by the number of its revolutions, which are registered.

1266. (Mr. Ellis.) At page 16 of the First Report of the Select Committee on the Sewage of Towns, at question 776, Professor Way is asked "If you have made experiments on the power of soils to absorb the manure contained in sewage?—Yes. Will you inform the Committee what were the results obtained by you?—The results generally were these:—That in soils there is a great power, which, previously to my examination, I believe was not recognised, to separate from liquids containing manure—containing ammonia, for instance, and potash, and phosphoric acid, and magnesia, that is to say, all the important elements of manure, these elements; to separate them from water, not by mere filtration, because these things would pass through a filter, but by the peculiar chemical attraction possessed by the ingredients of a fertile soil for these liquids, so that if we were passing a liquid containing manure matters through a given quantity of soil, the water would pass through, and these manure matters would be retained and fertilise the soil. I look upon this as a great arrangement and provision of Nature for the preservation of manuring principles from being washed out of the soil by rains."

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

An improved mode of reducing iron from its ores, and purifying and refining the same. Richard Werdermann, civil engineer, Prince Street, Surrey. February 10, 1873.—No. 474. My said invention relates to an improved mode of applying electric currents in order to reduce metals directly from the ores with or without the ordinary chemical action of carbonaceous matter, and in purifying and refining at the same time and by the same process the metal during its reduction from the ore.

An improved mode of and apparatus for purifying and refining metals and alloys. Richard Werdermann, civil engineer, Prince Street, Surrey. February 10, 1873.—No. 475. My said invention consists in an improved mode of applying electric currents to remove the noxious elements mixed or combined with the metal or alloy, and to permit such noxious elements when required to be collected and purified; it also consists in improved apparatus whereby the currents are effectually employed.

A new or improved composition or paint to be used for coating metal and other substances. Walter Chidcock Nangle, Hull Point, near Devonport, Devon. February 11, 1873.—No. 495. This composition or paint is composed of coal-tar, rosin, plaster of Paris, dry red-lead, Spanish brown, and benzoin. The rosin is first dissolved by heat, the mixed with the plaster of Paris; to these are added some tar, red-lead, and Spanish brown, and when well mixed the remainder of the tar and other ingredients are added, and the composition is then ready for use. Benzoin is added. This paint is particularly recommended for pre-

serving iron, but may also be applied with advantage as a coating for other metals and substances.

Improvements in the manufacture of chlorine. Henry Deacon, alkali manufacturer, Appleton House, Widnes, Lancaster. February 11, 1873.—No. 505. This invention relates to improvements upon Deacon's chlorine process, and consists in mixing the active substance or substance employed with one or more substances of another class, which when used alone are inactive or inert, that is, do not possess the power of decomposing heated hydrochloric acid gas and air or oxygen in any material degree, but when mixed with the sulphate of copper, *ceteris paribus*, materially increases its activity, the residue of the sulphate of soda and sulphate of potash are types of this class of inactive but, so to say, accelerating substances.

Improvements in the manufacture of corks, and in the apparatus employed therein. Jules Salomon, cork manufacturer, 21, Rue Pavée, Paris. February 11, 1873.—No. 509. The invention consists—First, In testing the cork by submitting it to a pressure of 6 to 7 atmospheres in presence of pure or alcoholised water, in which cork of bad quality becomes spotted and black; the soft parts of the cork hollow out, and the cork itself assumes an oval form, and loses its form if the cork is of good quality. Secondly, In forming the corks of pieces of thin cork of good quality grouped together so that the front of the bark shall form the circumference of the cork, and the hard veins in supporting each other form a cork of equal elasticity throughout its diameter and very strong; and in attaching these pieces together by means of a solution of dry india-rubber before being pressed together, partly in cementing a disc of cork for the head of the cork. Thirdly, In forming the corks of two pieces of cork back to back with a cement of india-rubber so as to leave the front outside. Fourthly, In covering the corks of an inferior quality with a sheet cut from cork of good quality parallel to the hard layers of the bark.

An improved process to be employed in the manufacture of manures, and machinery or apparatus therefor. Samuel William Maquay, Charlemont, Terrace, Dublin. February 12, 1873.—No. 511. This invention consists in manufacturing manures from coprolites or similar substances by the continuous application and employment of acid and other gases within closed vessels in connection with endless elevators and revolving rollers.

Improvements in the manufacture of manure and apparatus therefor. Hugh Campbell, physician, 38, Queen Anne Street, Cavendish Square, Middlesex. February 12, 1873.—No. 513. To saturate absorbent and nitrogenous substances with solutions and liquids containing ammoniacal salts, ammonia, or its chemical elements, and afterwards to reduce the combinations so obtained to powder, so as to facilitate their rapid, cheap, and easy distribution over land.

Improvements in obtaining oxygen. Charles Weightman Harrison, High Holborn, Middlesex. February 12, 1873.—No. 518. This specification describes obtaining oxygen from atmospheric air by passing the air into suitable porous substances or by precipitating the oxygen of the air by magnetic or electro-magnetic action.

The manufacture of a new composition for the removal and prevention of incrustation in steam-boilers. Charles Burdett, civil engineer, Sutton House, New Wimbledon, Surrey. February 13, 1873.—No. 518. The above composition not only effects the removal of old deposits, and prevents any fresh incrustation from forming, but effectually preserves the iron, and at the same time is free from any ingredients that are poisonous to the cocks, valves, or other portions of the machinery. The composition is manufactured in three forms for the convenience of users. The block form can be applied to stationary boilers through the man-hole. The liquid form can be applied to stationary or locomotive boilers through feedwater cistern, or through safety-valve by shutting off the steam. The paste form contains ingredients almost identical with the liquid, and it is in fact a highly condensed form of the liquid. It is manufactured for the especial purpose of saving space and expense in transit. On being liquidised in warm water it can be applied to boilers in same manner as the liquid form.

Improvements in the manufacture of sulphurated lead, in apparatus therefor, and in its application to various useful purposes. James Noad, engineer, of Bower Road, Hackney Wick, in the county of Middlesex. February 13, 1873.—No. 519. My invention relates to the manufacture of a compound of sulphur and lead, which possesses very peculiar properties, and is applicable to many useful purposes. I use two pots placed over separate fires, and connected by pipes with a mixing chamber. The latter is provided with an inlet pipe for air or steam, and an outlet pipe leading to a condenser. It also has a rake or rattle. I melt lead in one of the aforesaid pots, and sulphur in the other; when the lead is heated to about 710° F., and the sulphur to its melting-point, I open the communications, allow the liquids, the proportion of 5 parts lead and 1 part sulphur to flow into the mixing chamber. The lead has by this treatment been converted into a dark grey brittle powder. The said powder, after being ground, sifted, bolted, or floated, and dried, will be ready for use for various purposes.

TO CORRESPONDENTS.

R. Brown.—Nearly neutralise with carbonate of soda, and precipitate the gold in the metallic form with protosulphate of iron.

R. Riley.—(1.) Write to "Rubber and Cork," foreign booksellers, Ludgate Hill; for the American "Rubber and Cork," they are published weekly. (2.) About the end of the present year.

BOOKS RECEIVED.

The Worthies of Cumberland. By Henry Lonsdale, M.D. G. Routledge and Sons.
An Easy Introduction to Chemistry. Edited by the Rev. Arthur Rigg, M.A. London, Oxford, and Cambridge: Rivingtons and Co.

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Analysis of Food, Water, and Air.—Mr. WANKLYN has opened a Laboratory at 117, Charlotte Street, Fitzroy Square, and is prepared to give Practical Instruction in Chemical Analysis to Medical Officers of Health, and to persons proposing to undertake the duties of Public Analyst under the new Act.

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Practical Instruction in Mineralogy and Geology is given by Prof. TENNANT, F.G.S., at his residence, 149, Strand, W.C.

ROYAL POLYTECHNIC.—Notice.—THE ENCHANTED GLEN (written by Dr. Credit), notwithstanding its great popularity, cannot be given after November 3, in consequence of the engagement of Mr. Howard Paul. This week's poor representation; Mr. Hartwell. New Lectures by Professor Gardner:—1. "The Silver Light," 2. "Sugar, from the Cane to the Tencup," 3. "Home Electricity," Mr. King. Other Novelties.—Open daily, 12 to 5 and 7 to 10. Admission, 1s.

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THE CHEMICAL NEWS.

VOL. XXVIII. No. 727.

PUBLIC ANALYSTS.

A NUMBER of important chemical appointments have been created by recent legislation, and it is matter of notoriety that some of these appointments are filled by persons only very imperfectly qualified to discharge the duties devolving upon them. We allude to the public analysts, and invite our readers to inspect the official list of these appointments. It is indeed doubtful whether there exist in this country a sufficient number of duly qualified persons to fill all these offices; and we observe, accordingly, a very portentous development of pluralism—one gentleman and his assistant (or coadjutor) having been actually appointed public analyst for no fewer than *seventeen counties*. As we have said, there is a dearth of competent analysts, and to some extent pluralism is excusable. We can, however, hardly avoid thinking that the exigencies of the case do not warrant the entrusting of so many of these appointments to the same hands, and we hope that, on the expiration of the official year, these gentlemen will be relieved of a portion of the burden and responsibility which has been laid on their shoulders. Passing from the office holders to the work which they have accomplished, we have to note an unpleasantly large number of errors, and a growing distrust of the official analyst.

Liverpool and Glasgow have, each of them, had their butter-scandal, and even the milk-analysis of a public analyst has been called in question. In London there have been alum-convictions of the most doubtful character, and, at the present moment, there is a tea-controversy in Birmingham.

It was indeed inevitable that, on the first establishment of the office of public analyst, there should be a good deal of blundering on the part of the officer; and it is perhaps matter of congratulation that the early blunders have been so very patent and instructive. A fact which might otherwise have been ignored has been made very apparent, namely, that the ordinary laboratory course which a chemical student passes through in this country, is totally inadequate to prepare him for the discharge of the new duties, and that special instruction is imperatively demanded. It has curiously enough happened that the most notorious and picturesque failures, on the part of the public analyst, have been instances where the analyst had enjoyed the advantage of the ordinary analytical course, and where he probably presumed on the adequacy of such a training.

If we had been asked to say beforehand how it would be, we should have been disposed to point to the medical man, with a smattering of chemistry, who had taken office on the strength of the smattering, and should have looked for striking blunders from that quarter. And no doubt, too, there will be cases of wonderful failure of this description. The danger from this source is indeed so real as to need no special illustration; and it is well that the early working of the new regulations has proved an illustration of dangers which were by no means obvious.

THE POLLUTION OF RIVERS' BILL.

(SECOND ARTICLE.)

BEFORE proceeding further with our examination of this Bill, and of the evidence laid before the Committee of the Lords, we cannot help quoting a portion of Sir W. Fergusson's address delivered at the meeting of the British Medical Association, just to remind our readers that the chemical point of view is not the only one from which the water question may be regarded:—"Supposing that the greatest chemist in the world places a pint of pure water, absolutely without alloy, at the meal of his fellow man, let us, as medical men, do what the community at large cannot, trace this fluid until it is no longer palpable. Take as a type the pet of the day, the 'working man,' allow him to be a model teetotaler who has taken a vow against alcohol and all fermented liquors. He takes his frugal meal—say water and bread. Trace that meal as far as your physiological imagination can, down the intestinal canal, and into the blood, and fancy, from your knowledge, the affluents thereon. Can 'pure water' be recognised beyond the teeth in this downward course? Mucus, saliva, tonsillary secretion, mucus again and gastric juice, and pancreatic and biliary, all join the ingredients of that simple meal. But let us suppose the working man indulges in the luxury of a bit of beef or mutton, with some of the usual adjuncts; what is the fate of the pint of pure water, which is deemed the grand feature of this excellent fare? Here vegetable and animal matter are joined with pure water to an extent a thousand times beyond the imagination of the pure water theorist. Look even at the condition or risk of the epicure, whose means permit him to indulge in the high-flavoured grouse or daintily managed venison, and suppose him a 'pure water' man, what becomes of the water as soon as swallowed? What about the pleasing adjuncts to these delicious articles of food, and what (to those who are always referring to salts in water) about the common salt which is consumed in quantities palpably larger than those pointed out by the chemist in so-called saline waters?"

Do we, therefore, disapprove of the movement for improving, wherever and however practicable, the condition of our streams? No more than does Sir W. Fergusson himself. But we do most earnestly protest against this movement being made subservient to the vanity and the ambition of any man, or being employed for the consecration of unwise crotchets.

To return to the Rivers' Bill. Dr. Frankland, in his evidence, brings forward the names of a number of scientific men of very various degrees of eminence, who, as he asserts, pronounce his "standards perfectly practicable, and recommend them strongly." Hearsay evidence is not generally considered very reliable. We should like to hear these chemists examined as to their alleged approval of these "recommendations," and called upon to state their reasons for deeming them practicable, judicious, or expedient. We fear that, before such an examination had proceeded, very far, Dr. Frankland's admirers would be very much reduced in number. No authority can justify such an assortment of errors and omissions.

The following passage is worthy of public attention:—"Lord Aveland: Does that sewage farm (Merthyr Tydfil) pay? Dr. Frankland: I should think not. If you were to debit against that farm the cost of draining the land, and the cost of bringing the sewage to it, it certainly would not pay. Even an irrigation farm where you spread the sewage over an enormously larger area of land does not always pay."

Dr. Frankland also believes that if an act which compelled the purification of water—we presume on "recommendation" principles—were put in force, it "would greatly benefit nearly every manufacturer in the country individually."

The gentlemen who gave evidence on behalf of the various manufacturing interests concerned expressed a

very natural doubt as to the practicability of the scheme proposed. It is interesting to observe how their scruples were met. The case of the Alkali Act was duly paraded before the vision of the public. In that instance manufacturers were ordered by the law to do something which had not been customary, and which was generally deemed impracticable, to condense, namely, 95 per cent at least of the hydrochloric acid gas generated in their establishments. They succeeded in doing much more than the law demanded, and that not without benefit to themselves. But it is questionable logic to assume that, because one such piece of audacity proved so splendidly successful, a similar fortune will always await enactments of this kind. Who have been louder than the Rivers' Pollution Commissioners in expressing their conviction of the impossibility of dealing with town sewage by chemical means? Yet the liquid refuse of manufacturers is no less complex, no less dilute. Since their "recommendations" were put forward, moreover, the price of fuel has greatly risen, and an additional difficulty has thus been placed in the way of the remunerative treatment of such refuse.

But space does not allow us to linger any longer over clause 6 and its shortcomings. Other gems await our notice. Clause 15 informs us that, if pollution is proved against any person, judgment shall be given against him, "notwithstanding that it may appear that the particular pollution complained of is not separately appreciable, by reason of the existence of some other pollution in the neighbourhood." This clause gives facilities for a process of unnatural selection. Small offenders may thus be seized upon, while greater ones escape. This clause, besides, establishes the principle that a man may pollute a river, and incur penalties, by pouring into it water cleaner than the river in question.

Clause 16 speaks of repeated acts which may be held together to cause a pollution, though each act, taken by itself, may not be sufficient for that purpose. This clause is full of doubt, and therefore of danger. Are we to understand that liquids coming within the recommendation standards may yet, under certain circumstances not named, be held polluting?

Worse still is clause 21. This Act is not to be the sole and all-sufficient method of dealing with the pollution of rivers, but it is to be "in addition to" any powers which existed before. This is simply to create and foster complexity and confusion. Fix your standards high or low, but let the manufacturer know that, when these are fairly obeyed, he is safe. If the Bill is not to be all-sufficient, clause 6 notwithstanding, why pass it? Is not this very 21st clause a confession of worthlessness?

But the end crowns the work. We read with admiration that this Act "shall not affect any outfall or other works of the Metropolitan Board of Works (though beyond the Metropolis), or take away, abridge, or prejudicially affect any right, power, authority, jurisdiction, or privilege of the Metropolitan Board of Works." In other words, the greatest offender is to go scot-free! The corporations of Liverpool, of Manchester, of Birmingham, of Bristol, of Leeds, will find their privileges most disagreeably affected if they presume to pollute their respective streams and rivers. But what is sauce for the goose is not sauce for the gander. Crossness and Barking are still to be left free to pour pollution by millions of gallons daily into Father Thames. This looks very like an attempt to buy off the opposition of the Metropolitan members. But what will be the result upon the provincial cities and towns. If it does not stimulate them to the fiercest opposition they must be more—or less—than human.

One more point must not be overlooked. The Bill, stipulating for the exclusion of waters containing "organic nitrogen" beyond certain specified proportions, says nothing of the manner in which the amount of such organic nitrogen is to be ascertained. The public have a right to demand a guarantee that the process employed shall not be a well-known one, which is almost universally acknowledged to give erroneous results. Manu-

facturers must not be mulcted in severe penalties according to the results of a fallacious procedure. It is very possible that this Bill, as it stands, may not become law. Unless the "recommendations" are expunged or fundamentally modified, unless it is made a Bill for testing rivers as well as their inlets, and unless the clauses for making it practically null and void are cancelled, it must be our duty to warn both the authorities of provincial towns and all manufacturing chemists to oppose it at every stage of its career. That we need a good Act on the subject is no apology for passing a bad one. The Rivers' Pollution Commission, we are told, expires at the end of this year. It will serve to moderate our regret if its works follow it.

THE IRON ORE OF THE BIDASOA, AND ITS TREATMENT BY CALCINING AND LIXIVIATION.

By Dr. ERNST RÖHRIG, M.E., and ROBERT HAAS.

THE iron mines of the English Mining Company in Iron are situated on that part of the Pyrenees which runs alongside of the river Bidasoa, in the Spanish provinces Guipuzcoa and Navarre.

The ores occurring in these mines are less known than those of the province of Bilbao, which are of great renown, chiefly on account of the large deposit of good iron ore at Somorastro.

The ores of the Bidasoa have been worked on a large scale only a few years; this short time has, however, been sufficient to prove the vast extension of the ore and its excellent quality. The ore is particularly fit for the production of Bessemer pig, as it contains no phosphorus, and on the other hand it contains an amount of manganese.

The proximity and easy access to the Bidasoa from all mines of the Company allows a cheap transport of the ore to the railway station at Hendaye; besides which a railway for conveying the ore is in course of construction, so as to afford the means for transporting any quantity of ore from the mines to the various places of embarkation.

Thus the gain by selling the ore is not inconsiderable; it could, however, be increased three- or four-fold if the ore were converted into pig in the neighbourhood of the mines. The ores occur in lodes of steep inclination, and of an average width of 4 or 5 metres.

The lodes are chiefly found in a formation which here occurs in masses, and is termed by Charpentier granite formation. As, however, the mineral contains no mica, and essentially consists of quartz, orthoclase, and hornblende, its proper termination would be syenite. Other lodes of iron are found in siluric rocks adjoining the syenite, and also in limestone belonging to the trias formation.

The ore itself consists almost exclusively of spathic ore, which is usually transformed into brown iron ore in the parts nearest to the surface. The quality of the ore may be judged from the following lists of analyses:—

1. ORES FROM SAN CARLOS MINES.

(a). Spathic Carbonate of Iron.

Iron	34.27	42.08	39.99	36.75
Manganese ..	1.82	2.54	3.99	6.05
Sulphur	0.09	0.06	0.03	0.04
Silica	—	9.80	5.48	6.87

(b). Brown Iron Ore.

Iron	48.53	51.02	49.83	26.16	16.67
Manganese ..	3.39	3.84	4.87	13.29	43.13
Sulphur	—	0.04	0.03	—	—
Silica	—	9.49	9.44	—	—

II. ORES FROM THE "ALBION" MINES.

(a). Spathic Carbonate of Iron.

	41'23	40'05	38'75	40'20
Iron ..	2'77	3'77	3'72	4'00
Manganese ..	0'15	0'27	1'39	0'64
Sulphur ..	7'88	3'44	—	—

(b). Brown Iron Ore.

	54'63	52'25	52'64	54'20	47'66	52'70
Iron ..	0'25	0'40	0'45	0'78	1'84	4'44
Manganese ..	0'04	0'03	0'07	0'08	1'36	0'99
Sulphur ..	9'36	12'70	14'30	—	12'32	—

III. ORES FROM THE "THREE CROWNS" MINES.

	Brown Iron Ore.		Spathic Ore.		Brown Ore.	
Iron ..	55'61	56'47	41'67	44'15	—	—
Manganese ..	0'38	0'90	3'70	4'29	—	—
Sulphur ..	0'16	0'06	0'05	0'12	—	—
Silica ..	4'09	4'03	3'02	17'32	—	—

IV. ORES FROM THE "SAN BENITO" MINES.

Spathic Ore.

	36'88	39'52
Iron ..	2'71	2'86
Manganese ..	0'06	0'06
Sulphur ..	20'53	13'65

The excellent quality of the ore is further proved by the fact that these ores have been worked for many centuries in Catalan forges with good success, and in many places they are still worked.

The above analyses show also that some of the ores contain a considerable amount of sulphur, and although these sulphurous ores form but a comparatively small portion of the whole, trials for removing the sulphur, by means of a suitable calcination and lixiviation, have been made by us. These trials were carried out most successfully. By means of an oxidising calcination we obtained satisfactory results, shown by the following analyses:—

Spathic Ore of San Miguel.

	Raw Ore.	Calcined Ore.
Iron ..	42'19	54'43
Sulphur ..	0'54	0'16

Spathic of San Benito.

	36'07	50'34
Iron ..	0'34	0'18

The amount of sulphur remaining in the calcined ore is so small as to allow of a direct smelting of the ore in blast-furnaces, with an addition of limestone, which will remove the last trace of sulphur. Still better results were obtained by treating ores containing a large amount of sulphur, although the calcining oven at disposal was of imperfect construction, having been used formerly for burning lime, and had to be re-constructed for our purposes as far as circumstances would allow.

In order to find out the limit to which sulphur may be removed by a suitable calcination and methodic lixiviation, we have artificially mixed ore, so as to contain 21 per cent of sulphur. The results obtained by the treatment of this highly sulphurated ore are shown by the accompanying analyses. (See next column).

The lixiviation of the ore has been considered as finished when a sample of water taken from the apparatus for lixiviation, after being acidified with hydrochloric acid, did not give any more reaction with chloride of baryta.

The small quantity of sulphuric acid, i.e., 0'15 per cent, corresponding to 0'06 per cent of sulphur, as shown by analysis III., proves that the lixiviation had not been carried on long enough in the apparatus. We have removed it by a subsequent boiling of the ore in the state of powder, when it was shown that 0'07 per cent of sulphur could not be removed, and remained in the ore. The

Components.	I. Raw Ore.	II. Calcined Ore.		III. Lixivated Ore.	
		(a).	(b).	(a).	(b).
		Analysed.	Calculated.	Analysed.	Calculated.
FeO ..	10'97	—	—	—	—
Fe ₂ O ₃ ..	36'45	73'47	73'73	76'97	75'30
FeS ..	—	4'74	—	—	—
FeS ..	—	0'19	—	0'19	—
MnO ins.	2'67	—	—	—	—
" s.	—	0'36	—	—	—
Mn ₂ O ₄ ..	—	3'22	3'43	3'67	3'29
Al ₂ O ₃ ins.	0'60	0'46	—	0'41	0'48
" s.	—	0'10	—	—	—
CaO ins.	0'41	0'22	—	0'31	0'21
" s.	—	0'56	—	—	—
MgO ins.	0'63	0'51	—	0'33	0'53
" s.	—	0'15	—	—	—
CO ₂ ..	14'76	—	—	—	—
SiO ₂ ..	14'36	19'75	17'14	17'09	20'79
SO ₃ ..	—	1'70	3'75	0'15	—
H ₂ O ..	5'13	—	—	0'43	—
	99'72	100'69	100'00	99'55	100'00
Fe total	43'26	51'55	51'61	53'99	52'71
Mn ..	2'07	2'59	2'47	2'65	2'37
S ..	2'53	0'75	—	0'13	—

* Ins. = in insoluble combination; s. = soluble combination.

† As it was not possible to determine the state of oxidation of the Mn, we have taken it for granted that the Mn is transformed, by the calcining process, into Mn₂O₄.
‡ The total amount of sulphuric acid formed out of FeS₂, after half of the sulphur has been evaporated.

same result would have been obtained undoubtedly by a further lixiviation in the apparatus. The remaining sulphur, 0'07 per cent, consists of FeS, and is taken as such in calculation in analyses II. and III.

To control the latter analyses, we have made calculations contained in the two columns (b), by which we also proved that calcination, as well as lixiviation, has been perfectly rational. Our calculations are founded on the supposition that, under the process of calcination, all the water and carbonic acid are evaporated, while the oxidisable components of the ore take a higher state of oxidation; thus FeO and MnO will form Fe₂O₃ and Mn₂O₄, and FeS₂, losing 1 equivalent S, is transformed into Fe₂O₃ and SO₃.

The small differences found by comparing the columns (a) and (b) are chiefly founded in the inevitable differences which always arise in taking samples at different times from the same heap, and it may be possible that some mechanical loss of ore has taken place in the process of lixiviation. The analysis II. is composed of two analyses, containing the soluble part and insoluble part of the ore. 100 grms. of the calcined ore has been boiled until all the soluble parts were extracted; their composition is the following:—

MnO ..	0'36
Al ₂ O ₃ ..	0'10
CaO ..	0'56
MgO ..	0'15
SO ₃ ..	1'70
	2'87

Total, 2'87 grms. of sulphates, contained in 100 grms. of calcined ore, and if calculated for 100, the following lixiviated salts appear:—

Al ₂ O ₃ SO ₃ ..	11'50
MnO SO ₃ ..	25'78
CaO SO ₃ ..	47'39
MgO SO ₃ ..	15'33

100'00

or very nearly a salt composed of 1 equiv. Al, 5 equivalents Mn, 10 equivalents Ca, and 4 equivalents Mg, if calculated on the foundation of their equivalent weights. The amount of

insoluble components (*vide* Table, "ins.") was found by deducting the soluble components from the total analysis of the calcined ore.

It was not possible to ascertain the total quantity of soluble salts and their weight in a direct way, as part of the salts loses its composing water at a lower temperature, and as the sulphates of alumina and manganese are decomposed at a higher temperature. However, we ascertained that sulphate of lime first separated, when boiling the lixiviated salts to dryness.

The lixiviation had a weak, sour reaction, as sulphate of alumina has this property even as a neutral salt.

The determination of sulphur was made in all the three analyses with especial care. We applied the dry way (with soda and saltpetre), and also the wet way (with hydrochloric acid and chlorate of potash), and our figures represent the average of various analyses. Chloride of iron was removed from the solution before adding the chloride of baryta, which was done to the solution in a boiling state; the solution was kept boiling for half an hour, and kept for twelve hours more at a temperature of about 40° before the precipitation of baryta was filtrated.

The analysis of the soluble salts proves the interesting fact that no iron whatever has entered into solution, as is generally supposed, although in the present case sulphuric acid, in sufficient quantity for the formation of vitriol of iron were at disposal.

The same fact took place in the calcination of other kinds of manganese ores; in all cases, not a trace of iron could be ascertained. The presence of manganese, together with that of Ca, Al, and Mg, seems to prevent the formation of sulphate of iron, in case these bases be present in sufficient quantity to neutralise the SO_3 that has been formed.

The most favourable result of having reduced, by the calcining and lixiviating processes, the original amount of sulphur in the raw ore of 2.53 to 0.75 per cent and 0.07 per cent respectively, we think must be attributed to the presence of Mn and Ca in the ore; and the behaviour of manganese ores of the Bidasoa during roasting makes it probable that manganese acts, in the calcining process, for the removal of sulphur, in a similar manner as it is known to act in the various iron and steel smelting processes.

We intend to make comparing trials with ores rich in sulphur and free from manganese at the same time.

Iron, Sept. 1, 1873.

SEWAGE AND THE UTILISATION OF ALUM SHALE.

By SIDNEY W. RICH.

THAT the purification and utilisation of sewage is still a problem requiring solution is known to most persons; it is, however, not so well known that unnumbered tons of a material which is well suited to break the back of the difficulty now lie waste—I speak of the alum shale cropping up at Whitby, Guisborough, and in other parts of England and of Scotland. This shale has long been used for the manufacture of alum and epsom salts, but the process employed being a crude, wasteful process, the works have one by one broken down, being unable to bear the competition with more modern works and more modern processes developed at Manchester, Newcastle, Goole, and elsewhere. Nevertheless, this shale is peculiarly adapted to the manufacture of alumina salts, and, consequently, is likely to render material assistance at all events towards a partial solution of the sewage difficulty.

The final opinions of the British Association Committee on the Utilisation and Purification of Sewage embraced the statement that, "by properly conducted sewage irrigation, a solution is afforded to the question of sewage utilisation," while, at the same time, "a precipitation process, or some clarifying process, may be found useful."

Few people will deny that some clarifying process should be applied to the sewage before it is run on to the land; indeed, it is probable that, if effluent water alone were used for irrigation, choking of the land would be less likely to occur, and, consequently, the land would take more sewage and cause less annoyance. Fewer people still will deny that, if the sewage is to be run into a river, it is still more necessary to employ an efficacious precipitation process, in order that the effluent water may be as free as possible from obvious impurity. In either case a cheap precipitating agent is required, and there can be no doubt that in some form of soluble alumina only can we find such an agent. Practically, if the effluent water is to be used for irrigation purposes, a very small quantity of alumina will sufficiently clarify the sewage; on the other hand, if the effluent water is to flow directly into a river, a large quantity must be used. To test the results afforded by these different degrees of clarification, I have experimented on a very large scale at the Tottenham Sewage Works, and I find that, by reducing the amount of soluble alumina to the lowest figure compatible with the production of a clear effluent water, a deposit may be easily obtained, containing, when dry, 3 per cent of ammonia. I obtained, however, a different result when I aimed at getting an effluent water as pure as possible—the quantity of precipitating material being increased, the ammonia in the deposit was proportionately decreased. I would therefore clarify the sewage more or less perfectly according to its immediate destination; if irrigation is in view, a double profit may be expected—that on the application of the effluent water and that on the deposit. If, on the other hand, perfect artificial clarification is aimed at, regardless of the expense, the loss must be borne. With respect to the deposit, a great difficulty arises—it is by no means saleable. This must, however, be got over by special means in each locality. In dealing with the London sewage, and, wherever any large sandy area is available, it cannot be better applied than to the stiffening of the sand. Containing, as this deposit does, a large proportion of alumina, it is precisely the most suitable material that could be applied to sand. It should be partially dried, and then ploughed in, and the work, if in its first stages a loss, should be considered a national work of reclamation. A sandy tract, stiffened with this aluminous deposit, irrigated with effluent sewage water, and cropped with ryegrass, must, in the course of time, develop into a highly fertile area.

Many schemes are before the public, advocating the use of alumina in one form or another, commencing with potash-alum and ending with raw clay. The proper selection of the specific material may be advanced by a consideration of the requirements. The alumina should be in the soluble condition, and must be in a fit condition for transportation perhaps many miles; it must be comparatively cheap. These considerations alone will show to any reasonable creature the folly of using alum, and even sulphate of alumina at its present price. In a less degree, the unsuitability of clay, whether in combination with sulphuric acid or not, is evident. Sulphuric acid, as such, is far too expensive to be cast away by the ton, while clay becomes impossible immediately the question of transport arises. Where transport is necessary, a concentrated material must be used, and clay can never furnish this. And yet consideration will show that a combination of sulphuric acid and alumina—in other words, that some form of sulphate of alumina—is the only material which meets all our requirements; it contains a suitable proportion of soluble alumina, and is therefore portable, but at present it is dear. It is dear because its manufacture involves the use of sulphuric acid, which, alone, an expensive manufactured article. These considerations forced themselves on my mind eighteen months since, and I trust I shall not be accused of the endeavour to push a pet theory if I give an account of my subsequent action in the matter. Convinced of the necessity to

manufacture sulphate of alumina without the use of sulphuric acid, I set to work and experimented on the aluminous shale at Guisborough. As a result of my experiments I found that at a suitable temperature the burnt shale combined with sulphurous acid gas, provided air and moisture were present, sulphate of alumina being formed. To carry this out practically, I built a brick cell 15 feet high, and caused the shale immediately as it burnt, and while still hot, to sink into the cell. By withdrawing the burnt material from the bottom, and continually renewing the heap of burning shale at the top of the cell, I was able to keep up a continuous passing of material down the cell. I now caused the introduction of sulphurous acid gas at the bottom of the cell from a pyrites-burner; air and moisture were introduced at the mouth of the cell. Owing to the high temperature within, and to the joint presence of the several agents, the whole of the sulphurous acid gas was converted into sulphuric acid, and, in consequence, masses of the burnt shale came down in large part converted into soluble sulphate of alumina. This invention forms the subject of a patent, whilst an improved method of lixiviating the crude sulphate of alumina forms the subject of another patent. The method of lixiviation employed involves the treatment of the hot crude sulphate with water, in tubs which run on an inclined tram, and work on the principle of the lixiviating vats for alkali. The crude sulphate being lixiviated immediately it is removed from the cell, and while it is at a high temperature, the liquor becomes boiling hot, and may be drawn off at a highly concentrated point; indeed, very little expense is involved in the matter of fuel and evaporating-pans. The net result is that sulphate of alumina may now be profitably manufactured on the large scale for 25s. or 30s. a ton.

In the event of a cheap sulphate of alumina being utilised for sewage purposes, I would recommend the value of the article to be determined by the percentage units of soluble matter precipitable by ammonia, irrespective of its precise character, *i.e.*, of the proportion of soluble silica, precipitable lime and magnesia salts, &c., provided there were no more than some specified maximum oxide of iron present.

ON THE ENERGIES OF THE IMPONDERABLES, WITH ESPECIAL REFERENCE TO THE MEASUREMENT AND UTILISATION OF THEM.*

By the Rev. ARTHUR RIGG, M.A.

(Continued from page 201).

LECTURE V.

On the Energy of Electricity, with Especial Reference to the Measurement and Utilisation of it.

THE energy of electricity is being manifested in phases new to men day by day. That which in the early part of the present century was unknown is now so well known as to win neither surprise nor notice. The telegraph which girdles the earth—the electro-deposition of metals—the light which pales our brightest—the power which melts the most refractory metals (for I have seen a square bar of iron a foot in length, and about three-eighths of an inch on the side, fused into drops by a current of electricity in less time than this narrative has occupied)—these have been handed down by science to promote the commercial and social welfare of mankind.

What remains to be done by this energy, so recently harnessed, and as yet only partially trained, is beyond our present ken; but that it will—or, at least, that it can—be developed in a sufficiency to supply our coal-fields when exhausted, and take upon itself all that coal, and wind, and water now give of kinetic energy, no one who has watched the progress of the past need doubt; this, too,

quite irrespective of the view that owing to the quantity of zinc consumed electricity can never compete with coal in producing the same results. There is every reason to expect that long ere the coal-fields are exhausted the tidal waves on our coasts will be supplying light enough and heat enough, and, therefore, power enough, for the requirements of Great Britain and Ireland.

Propositions better established than that which asserts electricity to be non-producible from sufficiently economical sources have faded into oblivion.

The energies of electricity are manifested whenever there is a molecular disturbance within or amongst bodies. Whenever any change takes place in anything whatever, and amongst any molecules whatever, an electric current is produced, and if not necessarily manifested to us, still it always is present. Probably there is not a single act of our lives, and it may be not even a thought in our heads, which is not associated with an electric current.

Kindly understand that the lecture is on the energy of electricity, and, therefore, time must not be occupied in describing instruments. Galvanometers are now-a-days made so delicate that if you lay one finger in one trough of salt water, and another in another, and simply tighten the muscles of one arm, a current of electricity passes through the galvanometer and deflects the needle. We cannot raise our hands to our head without setting free a current of electricity, and in that current is energy. Its energy is manifested in the moving of the galvanometer needle. How much of that energy is merely the balance between two energies of large amount—how much is not manifested, owing to the sluggishness of the instrument and from other defects, we know not, but that some is thus interfered with there is very little doubt. We usually speak of a galvanic battery as being formed of zinc and copper, or of metals in chemically different relations to a liquid; if, however, you take a piece of ordinary copper bell-wire, and connect the two ends of it to the galvanometer, then cut it in two with a pair of scissors, and dip each cut end into salt and water, or put them into your mouth, an electric current passes, and the galvanometer shows that there has been some species or other of molecular disturbance which has caused a manifestation of electrical energy.

This energy of electricity becomes kinetic when it is allowed to pass freely. For example, in any bodies which are quiescent, it is kinetic, but it is potential when resisted. If, for instance, a current of electricity passes along a wire and the action is resisted, the wire becomes hot. If it passes through any compound body, as, for instance, water, then it is resisted, and the water is immediately decomposed. Consequently we are dealing to-night with an energy manifested in molecular disturbance, and having both a potential or stored-up power, and a kinetic power in motion. The question now is, how is this energy to be measured? for the subject of the lecture this evening is a mode of measuring the energy of electricity.

Towards the middle of the last century (about 1746) the first electrical machine was made. In 1650, Otto Guericke, to whom we are indebted for the air-pump, suggested the scheme, but Hawksbee was the first to make one. His machine consisted of a ball of sulphur, afterwards altered to a ball of glass. The hands were employed to rub it, and a large fly-wheel, about 6 feet high, was employed to turn it. Silk threads from the ceiling held what we now call the conductor; and by the exercise of a very large amount of mechanical power they were enabled to get a small spark, to the surprise of all, to the curiosity of many, and the dread of not a few. After that we come to the plate machine, which is arranged, as you are aware, with cushions; still we have those sparks which were supposed to have much energy in them. We then pass on from the glass plate machine to the vulcanite plate machine. Here is a vulcanite plate, and, as you are aware, by rotating it between cushions, the electricity is gathered upon this conductor. You see this large wooden ring—that was suggested by Winter

* The Cantor Lectures, delivered before the Society of Arts.

the object of it was, somehow or other, we do not know how, to condense the electricity, and to convert what might be a fine line spark into a solid whitish spark. How this ring acts, and the whole history of this machine, would be quite sufficient matter for one lecture; but that with which we are now concerned is not how to produce such phenomena, but how to attempt to measure the energy of the electricity which these machines, and other means, can develop. I scarcely need tell you that it is not, in any sense of the word, an electrical lecture in which we are to be engaged this evening, and these apparatus are only here as illustrations of the operations. Sparks pass from the conductor, and are usually charged into a jar of this kind—a Leyden jar. That was first done in the year 1746. The jars were charged and discharged, and although great shocks were felt, yet no measure was taken, and it was supposed that in the shock consisted the energy of electricity.

Now, the mode in which electricity thus presenting itself was ultimately measured was by a small jar of this kind, called a unit jar. This unit jar is in all respects the counterpart of the Leyden jar, only made smaller, and one is here mounted on glass and brass rods. There are two brass balls, one connected with the inside of the jar and one with the outside, which balls can be set at any distance apart. The inside of the jar is charged from the electrical machine, and as soon as it is sufficiently charged, according to the distance of the balls from one another, a spark passes. So passing, spark after spark enters the larger jar, and if we count the number of such entering we have settled what was supposed to be the measure of energy contained in the large jar. We may put in 10, 20, 30, or 40 charges. It will be very obvious to you, however, that these unit jars vary. The same jar is always alike, but you cannot make two exactly alike. Even if this could be done, the state of the atmosphere and other surroundings would so influence the passing electricity that accurate comparisons and conclusions could not be made. Moreover, these jars vary on the surface, and in the character of the glass, and in other ways; consequently this mode of measuring energy must necessarily be a failure. The unit jar, therefore, has fallen into complete disuse.

Hitherto the mode of producing the electricity to be measured has been by friction. Now, here is a machine, consisting of a thin circular vulcanite disc, capable of being put in rapid rotation, but there are no rubbers or other articles in contact with the plate. It is called a Bertsch machine. Here are three segments of thin vulcanite; one of these is rubbed with a piece of dry silk or fur, and, being slid in prepared grooves, the faces of the segment and rotating vulcanite are about one-quarter of an inch apart. These two other segmental pieces can be slid behind the first one; if the room and the atmosphere were not so damp we should probably get a 4-inch spark from this machine. One segment is rubbed, and placed about a quarter of an inch from the disc, and by a process of induction, when it is rotated, there is a noise as of much electricity being brought forward and gathered by the conductor. Again, we have here no quantity of electricity—we have no kinetic energy. The difference between energy as it is used, speaking electrically, and intensity, as it is also used, speaking electrically, is this, there may be great intensity and little or no quantity—no power, in the proper sense of the word. For example, if a piece of iron were taken and formed into needles, and if those needles were placed points downward upon the hand, and a small weight upon them, we should find that piece of iron was possessed of great intensity; but if this iron in rough block form, with any weight upon it, be placed upon the hand, although there be a very much larger quantity of iron, yet there is little intensity. In such a sense the distinction is drawn in electricity between quantity and intensity. There is great penetrative power in electricity obtained from this machine, but there is no quantity of

electricity moving, and upon the quantity in motion depends our ability to get energy. If all our iron appeared in the form of needle-points we should do very little with it.

There is another matter, also peculiar to electricity of this character, compared with the uses to which iron is now applied. Here is a small glass flask with crumpled pieces of tin-foil in it. If this flask were coated on the outside, as a jar is, the amount of intensity and the shock that would be given by it, would be equal to what might be obtained from that large jar, for this reason, the electrical balances between the inner superficial metal surface and the outer coating of the jar depend upon the intensity on these two. Electricity of this character rests upon surfaces only; electricity of that other character, with which we are more concerned, enters below the surface, and may be said to reside and travel within the body. Whatever, therefore, may be the number of, say, square inches of surface within the jar, the electricity upon the whole of them would be balanced by electricity of equal intensity upon an outer surface covering the jar only. This may be illustrated by a reference to the large quantity of water contained in a dock for ships. It is supported or kept at its level by a gate which in no respect is stronger than would be required for a dock of the same depth containing not one-tenth of the quantity of water. So with what is called the hydrostatic paradox, also so with Bramah's hydraulic press, and so with this little jar. There may be a large quantity of electricity within this jar if it have a large surface on which to distribute itself, and then it will be balanced or kept in equilibrium by a smaller surface on the outside charged to the same intensity.

The electricity here has been produced through physical exertion. We found, however, the other night that there is no physical exertion so great as that which takes place between the molecules of different bodies when chemical affinity is allowed to operate. If, therefore, instead of getting molecular disturbance in the muscles of our arms by turning these handles, we produce molecular disturbance between the ultimate atoms, or molecules of matter, forces are called into play as far beyond the power of our arms as those of the most colossal steam-engine are beyond the power of a mouse. By chemical arrangements we are enabled to obtain electricity of a totally different character from that hitherto noticed—to so different that there is little similarity between them, excepting a common name. In fact, the earlier attempts at telegraphy failed in consequence of the promoters using electricity produced by machinery such as this—an electricity which is possessed only of intensity, and not of that energy consequent upon quantity.

(To be continued.)

OBITUARY.

CRACE-CALVERT.

WE record with deep regret the death of Dr. F. Crace-Calvert, whose contributions to chemistry have so frequently enriched our pages. Crace-Calvert spent the early years of his life in France. After his return to England he became Honorary Professor of Chemistry in the Royal Institution of Manchester, which position he continued to hold up to the time of his death. In 1850 he was also Lecturer on Chemistry in the Pine Street Medical School, Manchester, an appointment which he does not seem to have held later than 1855. In 1859 he was elected a Fellow of the Royal Society. He was also a Corresponding Member of the Academy of Sciences of Turin, Honorary Member of the Pharmaceutical Society of Paris, and Corresponding Member of the Industrial Society of Mulhouse. He died on the 24th inst., at the age of 54. For many years we enjoyed the pleasure of his friendship, and few can give more able testimony to his worth as a chemist or his faithfulness as a friend.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopaedic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the *Chemical News*, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, September 29, 1873.

New Researches on the Analysis and Theory of the Pulse in the Normal and Abnormal States.—(Continued).—M. Bouilland.—The author here treats of lesions relative to the number and force of arterial beats, the rhythm of beats and repose of arteries and of the heart, the absence or temporary suspension of beats of arteries and of the heart, and the supposed abnormal diastole of the pulse. [M. Bouley, in a note following this one, points out that it is no new view that the arteries contribute, by their elasticity, to the circulating movement of the blood; having been held by John Hunter, Magendie, Dr. Blainville, and others; but M. Bouilland explains in reply that it is a certain systole or pulse of the arteries, rhythmic like the ventricular systole that he considers new.]

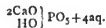
Observations on Subjects Treated in No. 21 of the *Memoirs by an Officer of Engineers*.—Gen. Morin.—Some facts as to the effects of German fire on the forts of Paris are cited from the work, which appears to be of some value in military engineering.

Note on Magnetism.—(Continued).—M. Gauguin.—In a permanent magnet the curve representing currents of detachment (*d'arrachement*) sinks very rapidly from the extremities to the heel, where it coincides with the axis. In an electro-magnet the curve is nearly a straight line in the interval between the two bobbins, parallel with the axis of abscissæ, and high above it. The increase of magnetisation from application of the armature is, in the latter, nearly uniform throughout the length of the bar; in the former it is much greater at the extremities than at the heel. The current of demagnetisation, produced on rupture of the inducing current when the electro-magnet is without armature, varies nearly as the intensity of the latter for a given point in the magnet. On the other hand, the current of detachment is about proportional to the square of the inducing current. Hence the relation of the current of detachment to the current of rupture itself varies as the intensity of the inducing current. In a series of experiments cited, the proportion of the two currents of demagnetisation was 62.8 with a weak inducing current, but it may be raised to 100. Again, the increase of magnetism in a permanent magnet from application of the armature is independent of the duration of contact. In the case of an electro-magnet, the reaction from application of the armature is effected in a very short time, but it is not instantaneous. The magnetic state was (under the conditions of experiment) appreciably modified during four or five seconds. M. Gauguin further experimented as to the apparently neutral state of magnets pointed out by M. Jamin; first, sending through the bobbins of an electro-magnet, having armature attached, a current of the intensity 17,980 (measured by a conical multiplier); then, after a few seconds circulation of this, a current of contrary direction and intensity, 8900, for a few seconds. After these operations the iron core does not possess any apparent magnetism, but it has the property of being magnetised more energetically in one direction than the other, when subjected to two equal inducing currents of contrary signs and of less intensity than 17,980. The magnetisation in any case was very slight, but could be

measured by the method of currents of detachment. Conformably to M. Jamin's observations the author found the inequality of the two magnetisms effaced as the current approached the intensity of 17,980. The apparently neutral state can be obtained a great many different ways, the iron having different properties in each case. The author supposes a superposition of alternate layers of contrary magnetism, positive and negative. He experimented by sending through the bobbins of an electro-magnet with armature—1, a current considered positive, of intensity 17,900; 2, a negative current, of intensity 11,100; 3, a positive current 5898. After this process the iron has no sensible magnetism, but it has the following properties:—When an inducing current of determinate strength is passed alternately in opposite directions the two magnetisations, positive and negative, are generally unequal, and their relation varies with the intensity of the inducing current. When this intensity is little above 5898, the negative magnetisation is considerably above the positive; with intensity 8606 the two magnetisations are equal; as the intensity continues growing the positive intensity becomes superior; it is much the greater for intensity 11,100; and, lastly, the two magnetisations become equal again for intensity 17,900. To explain these effects it must be supposed that the bar contains two layers of positive magnetism, separated by one of negative.

Zeitschrift für Analytische Chemie, Zwölfter Jahrgang, Erster Heft, 1873.

Determination of Phosphoric Acid in Baker-Guano and Similar Raw Materials (Malden, Jarvis, Enderberry, Starbuck, and Howland-Guano).—Dr. C. Gilbert.—A condition necessary for the correct determination of phosphoric acid in those methods where it is finally precipitated with magnesia-mixture, or estimated by means of a uranic solution, either gravimetrically or volumetrically, is that the acid should be present in the tribasic state. In the materials above mentioned the acid is in the tribasic state, but not always saturated with lime, sometimes magnesia and basic water replacing more or less of the lime. In many cargoes of these guanos lumps occur of nearly pure so-called neutral phosphate of lime—



sometimes in union with gypsum. Phosphoric acid is generally determined in a hydrochloric or nitric solution of the incinerated, and more or less strongly ignited sample. The half-phosphate of lime on ignition passes into pyrophosphate, which on solution in acids, and even on long digestion at a moderate heat, is not completely re-converted into orthophosphate. This error is most serious in volumetric determinations with uranic solution, and least in cases where the phosphoric acid has been separated with the molybdic mixture; since the prolonged digestion in the nitric-molybdic solution re-converts a large proportion of the pyrophosphoric acid into orthophosphoric. Bunsen's method, on Reynoso's principle, excludes this error, as it requires evaporation in strong, preferably fuming, nitric acid. Fresenius recommends, in his instructions for the determination of phosphoric acid in guano, to fuse the sample with carbonate of soda and nitre, thus at once oxidising all organic matter, and ensuring the solution of all phosphoric acid in the tribasic state. But this advice is neglected in practice. Stohmann even recommends, in his treatise on the commercial examination of manures, to dissolve the ash of guano direct in nitric acid, and to employ this solution in the determination of the phosphoric acid. The author recommends the following procedure:—25 grms. of the sample, dried if the manure is in a very moist condition, mixed with four times its weight of a finely-powdered mixture of 2 parts of carbonate of soda and 1 part of chlorate of potash, is to be kept ready. The

mixing is performed with a glass rod fused round at the end, in a capacious platinum crucible. The dust adhering to the rod is wiped off with a bit of Swedish filter-paper, and added to the mixture in the crucible. The flame applied is small, and is not brought very near, and under these conditions the ignition proceeds quietly without loss. As soon as the contents of the crucible are white the heat is increased, and the material is kept in flux for a quarter of an hour at full redness. When cold the crucible is placed in a beaker covered with about 150 c.c. of water, covered with a watch-glass, and about 30 c.c. of nitric acid, of specific gravity 1.25, are poured down the side into the beaker. The mass dissolves if no clay or sand is present easily and regularly. If silicic acid is present it is removed in the usual manner. The solution is then made up to 500 c.c., and used for the determination of phosphoric acid. The uranium volumetric method he modifies as follows:—100 c.c. are put in a beaker for a preliminary trial. The liquid is rendered faintly alkaline with pure soda-lye, and then made acid again with a little acetic acid. This procedure is preferable to adding acetate of soda. The solution can be at once titrated, as the raw materials in question rarely leave a distinct precipitate of phosphate of iron or alumina undissolved. Solution of acetate of uranium is then allowed to drop into the cold solution. The solution of ferrocyanide of potassium is to be prepared fresh daily, or the dry salt applied in powder. In gravimetric determinations of phosphoric acid the author recommends that the magnesia mixture be made without sulphate, which if present is partially deposited along with the double phosphate. The proportions are:—For 1 litre, 101.5 grms. crystalline chloride of magnesium ($MgCl_2 \cdot 6H_2O$), 200 grms. chloride of ammonium, and 400 grms. ammonia of sp. gr. 0.96. In the analysis of materials like ground bones, animal charcoal, and gelatinous bodies, the chlorate of potash in the fusion mixture is replaced with saltpetre. The Baker guano contains 45.93 per cent phosphoric acid; the Jarvis, 36.71 per cent; the Enderberry 44.11 per cent; and the Starbuck, 35.54 per cent. In an appendix Professors Fresenius and Marcker and Dr. Ulex express their approval of Dr. Gilbert's procedure.

Experience in Chemical Jurisprudence.—Heinrich Struve.—A paper on the detection of hydrocyanic acid in poisoning cases.

Detection of Grape Sugar along with Dextrin and Analogous Bodies.—C. Barford.—The author's object was to find a method of readily and certainly detecting small quantities of sugar in presence of a large amount of dextrin. A solution of acetate of oxide of copper, containing a small quantity of free acetic acid, 1 part of crystalline neutral acetate of copper is dissolved in 15 parts of water, and 200 c.c. of this solution are mixed with 5 c.c. of acetic acid, containing 38 per cent of anhydrous acid. A few drops only of the test-liquid are added to the solution in question, the mixture is boiled only for a moment, and if the reaction does not ensue forthwith it is allowed to stand for not more than a couple of hours. If set aside for a longer period without examination the precipitate formed may be re-dissolved. The same test-liquid serves for the detection of grape sugar, not merely along with gum and cane sugar, but also when associated with milk sugar. All these three bodies behave like dextrin. Solutions of milk sugar must not be too concentrated or suboxide of copper may be separated on boiling.

Method of Determining Sulphur of General Applicability.—A. Sauer.—This process is adapted for determining the sulphur in coal and coke. The sample is burnt in a stream of oxygen, and the sulphurous acid formed is collected, hydrochloric acid containing bromine. A full description of the process would be unintelligible without the accompanying illustrations.

Precipitation of Magnesia.—Dr. Mohr.—Magnesia is generally precipitated as an ammoniacal

solution which has been kept clear by means of sal-ammoniac by phosphate of soda. The precipitate, gelatinous at first, passes on standing into the crystalline double phosphate of magnesia and ammonia. If the liquid is filtered too soon, a further precipitate is formed in the filtrate, and it is necessary to filter again. The case is quite different when, instead of phosphate of soda, a solution of double phosphate of ammonia and soda is employed. A crystalline precipitate appears at once, and in a few moments it is completely deposited.

Contributions to the Qualitative Analysis of Vine Leaves.—C. Neubauer.—The author detected tartar, tartrate of lime, quercetin, gercitrin, tannin, starch, tannic and malic acids, gum, inosit, sugar, oxalic acid, a crystalline body soluble in ether, ammonia, phosphate of lime, and gypsum.

Comparative Determinations of Alcohol.—Dr. A. Kraft.—A lengthy paper on the different methods of determining alcohol in wines.

Prevention of Explosions During the Use of Apparatus for Generating Hydrogen Gas.—Dr. R. Fresenius.

Technological Chemical Gas Analysis.—H. Fresenius.—Both these papers would be unintelligible without the accompanying illustrations.

Volumetric Determination of Zinc.—O. Schott.—In the sulphide of sodium process the author recommends glazed card-paper (containing carbonate of lead) as an indicator.

Detection of Chlorine, Iodine, and Bromine in Organic Matter.—C. Neubauer.—A little oxide of copper is introduced into the loop of a platinum wire, and heated till it adheres. It is then dipped into the substance, or a little of the latter if dry is sprinkled upon it. The loop is then brought into the flame of a gas-burner moderately opened, near the lower and inner margin of the flame. The carbon burns first, and the flame becomes luminous followed by the characteristic blue or green colour.

Detection of Alcohol in Essential Oils.—R. Böttger.

Analysis of Cheese.—Alexander Müller.—This paper is unsuitable for abstraction.

Test for the Fastness of Turkey Red.—Armand Mueller.—Equal weights of the samples of dyed cloth or yarn are placed in equal measures of the following mixture:—10 vols. of alcohol at 96 per cent Tr., and 1 vol. hydrochloric acid at 1.18 sp. gr. Large quantities of the solution are used, and the whole is gently heated on the water-bath to about 50° C. The time is noted when each swatch become discharged. It appears that the greater the amount of alumina in a Turkey red the longer it resists the extra-drying mixture. The author concludes that the oil is only then serviceable when it has completely passed into that unknown, generally called oxidised, state in which it ceases to be soluble in ether.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, No. 250, October, 1873.

Report on Bloch's Feculometer (Farinometer).—Presented by M. Cloëz.—Potato starch, which is now used in constantly increasing quantities in the manufacture of dextrin and of glucose, is found in various states of hydration, in which the water ranges from 16 to 50 per cent. The intermediate stages are very difficult to identify by their appearance or touch. Bloch's instrument serves to determine the amount of water present in a manner sufficiently accurate for commercial purposes. It consists of a glass tube formed of two parts of different diameters; the lower, 0.220 metre long and 0.016 metre in diameter, is closed at one of its ends; it serves to contain the starch and indicate its value, for which purpose it carries a graduated scale. The upper part fused on to the lower tube serves for a funnel. It is a cylinder 0.180 metre long and 0.028 metre in width, and is closed

above a glass stopper. To graduate his instrument Bloch has set out with the principle that pure starch, not modified by heat or the action of acids, if in presence of an excess of water combines with a certain quantity of that liquid, forming, according to the author, a hydrate of known volume. After having exactly determined by drying the quantity of moisture contained in a sample of starch, if we take a quantity of such starch supposed to contain 10 grms. of dry farina, and place it in a graduated tube in contact with common spring water or river water, we find after a certain time that it occupies the volume of 17.567 c.c. This is the starting-point for the graduation and the construction of the farinometer. The lower tube should have a capacity of about 20 c.c. 17.567 c.c. are carefully measured into this tube, and the volume occupied by this is then divided into 100 parts of equal capacity. It is evident that each degree represents 1 per cent of dry farina. To make the assay an average sample of the starch is taken, and 10 grms. are weighed and introduced into the tube with common water. It is well shaken so as to beat up and mix the solid matter; then a slender stream of water is allowed to flow along the inside of the upper tube so as to rinse down all adhering particles of the starch. The apparatus is then set aside for an hour or two until the starch is deposited, and does not move if the apparatus is inclined on one side. The number of degrees on the scale occupied by the starch is then read off. This number represents the proportion in hundredths of real starch; if this, e.g., is 70, 100 kilos. of the sample contain 76 kilos. of starch, and 24 kilos. of water of hydration. This is the limit of composition of a commercial starch which does not roll into balls in the hand.

Report on Marine Glue, and on an Impermeable Liquid Glue.—M. Barral.—An account of the uses of two kinds of marine glue manufactured by Madame Audouin. The impermeable liquid glue serves to make troughs of paste-board for photographic purposes, capable of resisting the action of nitrate of silver, and even highly concentrated nitric acid.

Bulletin de la Société Chimique de Paris, tome xx., Nos. 4 and 5, September 20, 1873.

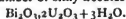
Use of the Hydrosulphite of Soda for the Titration of Oxygen and Oxidised Compounds, and on Certain Novel Facts Concerning Oxygen.—P. Schützenberger and Ch. Risler.—This important paper, which requires an illustration, will be given entire at an early opportunity.

New Experiments on the Respiration of Fishes.—Dr. Quinquand.—A physiological paper. The determinations of oxygen have been made by the method of Schützenberger and Risler.

Process for Determining the Hæmoglobin in the Blood.—Dr. Quinquand.—An application of the same method.

Researches on Indium.—M. C. Ressler.—The specific heat of indium requires its equivalents to be 113.4, and leads us to ascribe to its oxide the formula In_2O_3 . Hitherto this view has been unsupported by facts, but the author has succeeded in obtaining the alum of indium and ammonium, $\text{In}_2(\text{SO}_4)_3 \cdot \text{NH}_4\text{SO}_4 + 24\text{H}_2\text{O}$. This alum is very soluble, water at 16° C. dissolving twice its weight, and at 30° four times. The solution on boiling deposits a white powder. The salt is insoluble in alcohol.

Constitution of Certain New Uraniferous Minerals.—Cl. Winkler.—The following minerals have been found in the Weisser Hirsch mine at Schneeberg, and have been examined by Weissbach:—*Uranospinitite*.—Hemispheric brick-red masses which decrepitate on heating, and are resolved into a number of silky needles,—



Walpurgine, a basic arseniate of bismuth and uranium (Bi_2O_3)₂As₂O₅ + (U₂O₅)₂As₂O₅ + 10H₂O. On calcination this mineral turns brown, and after cooling appears of a

deep orange-yellow, without alteration in the form of the crystals. *Tragerite* (arsenate of uranium)—



forms yellow crystals, which lose water when heated, and become temporarily of a golden-brown without modification of form. Their yellow colour returns on cooling. *Zeunerite* (arsenate of uranium and copper),—



This mineral forms fine green crystals resembling chalcocite, or phosphate of uranium and copper. Chalcocite from Redruth contains 3 per cent of arsenic acid, whilst zeunerite is free from phosphoric acid. *Uranospinitite*, (AsO_4)₂Ca(UO₂)₂ + 8H₂O, is of a pale yellowish green and corresponds to uranite. If nitrate of uranium is added to a solution of oxide of copper in arsenic acid there appears a turbidity, and green crystalline lamellæ are formed, or, if the solution is hot, a crystalline powder agreeing in composition with zeunerite.

Detection of Tellurium and Sulphur in Ores.—G. Kustel.—To detect tellurium in ores which contain it in the state of telluride of gold the author uses sodium amalgam. The powdered ore is placed in a capsule with a little water and mercury, and afterwards a little sodium amalgam. If tellurium is present the water takes a violet colour. If it contains sulphur the water blackens silver-foil. If sulphide of iron is present the violet colour produced by the telluride of sodium may be masked by the precipitate occasioned. In such cases the water is poured off, a fresh quantity of water added, and the test is re-commenced with a fragment of sodium amalgam.

Reaction of Tellurous Acid.—F. Stolba.—Tellurous acid, mixed with an excess of alkali is reduced by glucose; if the solutions are dilute, and a large quantity of glucose be employed, the whole of the tellurium is deposited as a black powder. Selenious acid is not reduced under the same circumstances.

Apparatus for the Analysis of Gaseous Mixtures.—M. Orsat.—By means of an aspirator, which may be merely a bottle half-filled with water, and connected by a caoutchouc tube to a graduated jar which serves for measurement, and which may be raised or lowered by hand, we introduce into the jar 100 c.c. of gas. Then, by raising the aspirator, this gas is transferred into a first receiver which contains a solution of potassa at 40°; the carbonic acid is absorbed. The decrease of volume is noted. The gases are then transferred to a second receiver, ammoniacal hydrochlorate of ammonia and metallic copper, carbonic oxide and oxygen are absorbed, and a fresh decrease of volume is noted. What remains is nitrogen if the products of combustion are under examination. The volume of oxygen being known, if we deduct the quantity of oxygen which has been introduced along with it, and has served to form carbonic acid and carbonic oxide; then as oxygen is transformed into carbonic acid without change of volume, while it is doubled on becoming converted into carbonic oxide, the joint increase of volume of the oxygen, and the carbonic acid as compared with the initial volume of oxygen, represents half the volume of the carbonic oxide produced. Chlorine and sulphurous acid can be absorbed by means of suitable reagents.

Method of Printing Anilin Colours on Calico.—(*Moniteur de la Teinture*).—A solution of gelatin is prepared containing about 50 grms. to the litre of water. Solution of bichromate is added drop by drop till a straw-colour is produced; the anilin colour is then added, and the mixture thickened with dextrin or with roasted starch. After printing the pieces are exposed for some hours to light, which renders gelatin insoluble in contact with chrome. The gelatin may be replaced by a solution of casein in a small quantity of ammonia.

Reimann's Färber Zeitung, No. 35, 1873.

The Vienna Exhibition.—The display of dyed silks from Lyons is particularly beautiful. A novel feature is

the display of the various dye-ware along with the dyed goods. The paper-hangings in the English department are pronounced unique and splendid.

Dyeing and Finishing Plushes.—The author continues this subject in considerable detail.

Use of Epsom Salts in Dyeing.—In dyeing wool for goods which require to pass under the stocks, it has been observed for some time that an addition of epsoms gives greater permanence to the anilin colours, especially primula and methyl-violet. An addition of sulphurous acid is also found advantageous for the same colours. The colours are brighter and less inclined to rub off.

Cochineal-Red on Cotton.—To 10 lbs. of goods take 10 ozs. of tannin, and dissolve it completely in boiling water. Lay the goods over-night in the solution. Prepare some red liquor at 12° Baumé, and put into a small tub a sufficient quantity to work 2 lbs. of cotton yarn. Work the yarn for ten minutes. Fill up the red liquor to its original quantity, and work 2 lbs. more; and so on, till the whole of the yarn has been mordanted; it is then allowed to dry, with frequent turning. Piece-goods are winced for an hour in red liquor of the same strength. When dry, the goods are passed through a boiling bath of 1 lb. of prepared chalk to every 10 lbs. of cotton, and washed twice. 1 to 1½ lb. of cochineal is boiled out in water; a colour-bath is made up at 40° Reaumur, with the addition of a little flavin, and the goods are worked, raising the temperature slowly to near the boiling-point.

There are receipts for a Nicholson blue, a cochineal ponceau, and a magenta ponceau on silk, the colours for the latter being hydrochlorate of rosanilin and hydrochlorate of chrysianilin. There are also receipts for a claret, a mouse, and a drab on wool.

New Reaction of Saffranin.—If a few granules of the colour are mixed with 2 drops of concentrated sulphuric acid on a porcelain capsule, and stirred, a splendid blue colour immediately appears. The addition of 2 drops of water converts the blue to an emerald-green, and, by continued alternating additions of acid and water almost all the prismatic shades can be produced with remarkable beauty.

Revolution in the Alkali Manufacture.—According to R. Wagner, Leblanc's process is about to be superseded in England, Austria, and Germany. A solution of chloride of sodium is converted by bicarbonate of ammonia into chloride of ammonium and bicarbonate of soda; the latter crystallises out, while the chloride of ammonium remains in solution. This chloride of ammonium is distilled with limestone, and yields carbonate of ammonia, which is converted into bicarbonate by the excessive acid of the soda salt. No sulphur or sulphuric acid is needed. The soda obtained is very strong, and free from sulphur compounds. Plant, fuel, and labour are economised, and the escape of noxious gases is at an end. (As soon as we see this system at work we will examine its probable consequences—scientific, sanitary, and commercial.)

NOTICES OF BOOKS.

Ville de Bruxelles, Assainissement de la Senne. Utilisation des Eaux d'Égout de l'Agglomération Bruxelloise. Usines de Haeren, Irrigation des Plateaux Sablonneux de Loo et de Penthly. Par LEON DEROTE et CHARLES VAN MIERLO. Bruxelles: Baertsoen et Cie.

WORKS on sewage and its utilisation are becoming almost as plentiful and as agreeable as sewage itself. The pamphlet before us does not attempt to throw any new light upon this vexed question of modern times. Its authors, two "engineers of bridges and highways," content themselves with the easier task of repeating the questionable, or more than questionable, statements which circulate in England, and allowing them to mislead their country-

men. Had they, like the Prussian commissioner, Lefeldt, come and seen with their own eyes, we must, in common charity, suppose that their reports and conclusions would have been very different. Amongst the grosser errors, we find a statement that MacDougall's process—disinfection with sulphite of magnesia and carbolate of lime—has proved a failure. The fact is that the Carlisle irrigation-plot, where the sewage undergoes a preliminary treatment with these materials before being admitted upon the land, is almost the only farm of the kind which has neither given rise to complaints of nuisances nor proved a nursery of parasites. Whether it has proved a commercial success we are unable to state, but if not it has merely shared the common lot of irrigation-farms. With reference to the sanitary effects of irrigation-farms on their vicinity, a very important piece of evidence has come to light in a "Blue-book" lately issued, entitled "Progress of India for the Years 1871 and 1872," drawn up by C. R. Markham, C.B. We find it here stated that as early as 1847 an epidemic which was then experienced in the north-western provinces was more general and more severe than elsewhere. A committee of investigation recommended that irrigation should not be brought within 200 yards of the villages, and that a double row of trees should be planted round as a barrier. Now it is very true that nuisances of all kinds are less formidable in Belgium or in England than under the sun of India; but, on the other hand, in India irrigation is conducted with clean water, and is only applied when the rain-fall is deficient. If under such circumstances it is pernicious, how much more will this be the case when the land is irrigated continuously, and with offensive water. If a sewage-farm requires to be encircled with an uninhabited district, the expenses of the system, formidable enough already, will be still further augmented. We trust that our Belgian friends will not suffer themselves to be misled. Let them procure M. Lefeldt's pamphlet, and contrast its revelations with the loose statements of Messrs. Derote and Van Mierlo, and they will hesitate before committing themselves to irrigation schemes. The charge against precipitation, that it was unable to purify sewage, has been so strikingly refuted that it is tacitly withdrawn. Even the last ground of its opponents, the alleged worthlessness of the deposit as manure, is giving way before the irresistible logic of facts. Perhaps such manures *ought* not to produce remunerative crops, but they do, in spite of our theories. We cannot help saying that if Messrs. Derote and Van Mierlo will in future leave chemical questions—such as the treatment of sewage—to chemists, it will be better both for their own reputation and for the public.

MEETINGS FOR THE WEEK.

MONDAY, Nov. 3rd.—Royal Institution, 2. General Monthly Meeting.
THURSDAY, 6th.—Chemical, 8. H. Grimshaw and C. Schorlemmer, "On the Granulic Acid and Normal Heptyl Alcohol." D. Howard, "On the Optical Properties of some Modifications of the Cinchona Alkaloids." J. B. Hannay, "On the Expansion of Carbon Disulphide, and the Action of Iodine Trichloride upon that Substance." W. F. Donkin, "On the Estimation of Nitrates in Potable Waters."

Analysis of Food, Water, and Air.—Mr. WANKLYN has opened a Laboratory at 117, Charlotte Street, Fitzroy Square, and is prepared to give Practical Instruction in Chemical Analysis to Medical Officers of Health, and to persons proposing to undertake the duties of Public Analysts under the new Act.

Two Courses of Lectures on Geological MINERALOGY will be given at KING'S COLLEGE, LONDON, by Professor TENNANT, to which the public are admitted on paying the College fees. One Course is given on Wednesday and Friday mornings, from 9 to 10 o'clock, commencing Wednesday, October 5th, and terminating at Easter, 1874. The other Course is given on Thursday evenings, from 8 to 9, commencing October 6th. The Lectures are illustrated by a very extensive collection of specimens.

Practical Instruction in Mineralogy and Geology is given by Prof. TENNANT, F.G.S., at his residence, 149, Strand, W.C.

SUPPLEMENT TO THE CHEMICAL NEWS.

VOL. XXVIII. No. 727.

ESTIMATION OF SULPHUR IN IRON AND STEEL.

By T. J. MORRELL.

THE more common method of estimating sulphur in iron and steel consists in acting on the metal with sulphuric or hydrochloric acid, and precipitating some metallic sulphide by the evolved sulphuretted hydrogen. It would be a desideratum, in point of time, if this sulphide could be directly weighed.

By passing the evolved gases through an ammoniacal solution of cadmium oxide (or a solution of sulphate to which an excess of ammonia has been added), a precipitate of cadmium sulphide is obtained, which can be at once collected upon a small filter, dried at 212° F. and weighed.

The phosphoretted hydrogen, evolved in a solution of the metal together with the sulphuretted hydrogen, causes no precipitate in the solution.

The presence of ammoniacal salts would also prevent any precipitation of carbonate of cadmium by the traces of carbonic acid in the air drawn through the apparatus by the aspirator after the metal is dissolved. However, the aspirated air could easily be passed through potash solution, to remove its carbonic acid.

To prevent the precipitation of oxide of cadmium on the filter, the precipitate should be washed with distilled water containing diminishing quantities of ammonia.

If, in very accurate estimations, it is necessary to estimate the minute quantity of sulphur left in the solution and residue of the metal, this can be done as usual and added to that found as above.

Five test analyses of a piece of Bessemer steel known to contain 13 per cent of sulphur, gave as follows:—(1) 0.124 per cent; (2) 0.125 per cent; (3) 0.137 per cent; (4) 0.125 per cent; (5) 0.124 per cent.—*American Chemist*.

Cambria Iron Works, Johnstown, Pa.

ON CHLORIDE OF MERCURETHYL.

By J. M. MAISCH.

THIS compound, it appears, has recently been introduced in Europe into medicine, and it is claimed for it that it may be used in the same doses and for the same purposes as corrosive sublimate, over which it has the advantage of not precipitating albumen, no matter in what solution the latter may be, whether as egg albumen, in the serum of blood, in urine, &c. Schering and Co. have introduced it under the name of *Hydrargyrum athylochloratum*.

It was discovered by Strecker* and Dünhaupt† in 1854. The former chemist started with iodide of ethyl, preparing therefrom as the first step the iodide of mercurethyl; the process of the latter involves the previous preparation of bismuth-triethyl, which being decomposed by corrosive sublimate, yields the compound in question, besides chloride of bismuth-ethyl. Whichever course is followed, the process, or rather series of processes, are

tedious and complicated; but that of Strecker appears to offer better advantages in utilising all the material.

Iodide of ethyl or hydriodic ether = C_2H_5I , was discovered by Gay-Lussac in 1815, and prepared by distilling absolute alcohol with hydriodic acid, and separating the compound from the distillate by water. Serullas* subsequently improved the process by using iodine and phosphorus with alcohol, and Personne† found the use of amorphous (instead of ordinary) phosphorus very advantageous, using again absolute alcohol. The latter process was rendered more practical in 1862 by Reith and Beilstein,‡ who proposed to put 1 part of red phosphorus into 5 per cent of alcohol, sp. gr. 0.83, placing the flask with the mixture into cold water, adding 10 parts of iodine, distilling after twenty-four hours, shaking the distillate with soda solution, and removing the oily liquid which is rendered anhydrous and rectified. Lieben communicated, in 1868, to the Vienna Academy of Sciences, his observations that the chlorides of the alcohol radicals are converted into the iodides on being heated to about 130° C., with an excess of concentrated hydriodic acid. Wanklyn|| and De Vrij§ have simplified the preparation of iodide of ethyl very much by using absolute alcohol, to which a little more than one molecular weight of iodide of potassium is added, after which dry hydrochloric acid gas is passed into the liquid; or the hydrochloric acid is first passed into the alcohol and sufficient iodide of potassium added afterwards; after twenty-four hours the mixture is distilled, the iodide of ethyl separated by water and purified by washing, drying, and rectifying.

Iodide of ethyl is a colourless oily liquid of 1.93 sp. gr. at 15° C. (60° F.), of a strong and peculiar odour, and boiling at about 70° C. (158° F.). When digested with mercury or some other metals, ethyl compounds of the metals are obtained. In this manner and by taking advantage of the influence of diffused light, Strecker prepares the iodide of mercurethyl, re-crystallising the product from alcoholic ether. It forms then colourless iridescent scales, subliming at the temperature of boiling water, fusing at a higher temperature, of an unpleasant odour, and being decomposed by direct sunlight finally into mercuric iodide; its composition is C_2H_5HgI . If its alcoholic solution is precipitated by nitrate of silver and the filtrate carefully evaporated, crystals or a crystalline mass of nitrate of mercurethyl are obtained, which is readily soluble in water and almost as freely in alcohol.

This nitrate is easily converted into the chloride by adding to the aqueous solution of the former, muriatic acid or chloride of sodium, nitric acid, or, in the latter case, nitrate of sodium being separated in the aqueous solution.

Chloride of mercurethyl has the composition of C_2H_5HgCl : it forms white thin scales with an almost silvery lustre, and of a peculiar ethereal unpleasant odour; it is very sparingly soluble in cold water, little in ether and cold alcohol, but freely in boiling alcohol, crystallising again on cooling; it sublimates at 40° C. (122° F.) without fusing previously, and condenses in thin laminae; exposed to the air it evaporates completely, and heated in a water-bath it may be fused to a clear oily liquid, which evaporates without leaving any residue. When rapidly heated upon platinum foil it burns with a slight flame, the vapours having a disagreeable odour and a metallic taste. Being very poisonous, it must be handled with great care on account of its ready volatility. Schering regards it as pure if it is readily and completely volatilised, dissolves without residue in boiling alcohol, yields in alcoholic solution but a faint reaction of chlorine, and, with alkali, does not produce a precipitate.

It remains to be seen whether its inactivity upon albumen renders this new claimant for medicinal favour so

* *Ann. d. Chim. und Pharm.*, xlii., 57.
† *Journ. f. prakt. Chemie*, lxi., 399.

* *Ann. de Chim. et de Phys.*, xxv., 343; xlii., 115.

† *Comptes Rendus*, lii., 468.

‡ *Ann. d. Chem. und Pharm.*, cxvii., 250.

§ *Polyt. Centralbl.* 1867, 675.

§ *N. Jahrb. f. Pharm.*, xxi., 169.

much superior to corrosive sublimate and similar mercurials, that its good qualities would more than outweigh the dangers and uncertainties that must result from its ready volatility at our usual summer temperature.—*Am. Journ. Pharm.*

ATOMS.

DR. C. R. A. WRIGHT, commenting on some remarks made in an article in the *Athenæum*, writes as follows to that paper:—

In that article you have done me the honour of singling me out (not in the most tasteful manner, perhaps, but that is a matter of opinion) as the representative of a school of chemists, which numbers amongst its adherents many well-known names (as an example of which may be mentioned Sir Benjamin Brodie); the members of this school, though differing amongst themselves on certain details, yet agree on this main point, that they object to view the experimental facts of chemistry and the allied branches of knowledge, *solely* through the medium of one preconceived notion as to the ultimate nature of matter.

Speaking for myself, I fail to see the cogency of the reasons which lead a great number of modern chemists to the impression that matter can only be viewed as being made up of "atoms" of some sixty-five essentially different kinds; these atoms, when connected together in certain ill-defined ways, constituting the "molecules" of which the innumerable compounds now known are conceived as being made up. I admit willingly that this "atomic hypothesis," if once admitted, is in close accordance with very many physical generalisations (*vide* Maxwell's recent lecture on molecules); that it gives a clearer explanation of many chemical phenomena than has yet been afforded by any view based on other notions as to the ultimate nature of matter (*e.g.*, the notion that there is but one kind of primordial matter, all so-called elements and compounds being, as it were, allotropic modifications of this matter differing from one another in the amount of energy latent per unit of mass); and that, directly or indirectly, it has done immense service in extending the bounds of knowledge; but, notwithstanding the assertion of the President of the British Association, that there has not been shown to be "any inconsistency in the atomic theory, nor in the conclusions to which it leads," I yet venture to think that this "atomic hypothesis" is not capable of giving a clear explanation of many chemical phenomena now known to us, and that it is not consistent with other so-called Laws of Nature (*i.e.*, hypotheses that meet every case yet propounded by experiment or predicted beforehand).

To take a single case: there is no hypothesis that better deserves the term "Law of Nature" to be applied to it than Newton's fundamental postulate, that two very small portions of matter (and *ergo*, two atoms) attract one another with a force proportionate to the product of their masses, and inversely proportionate to the square of the distance between them. I fail, however, to see how the motions of molecules amongst themselves in diffusion, expansion, friction, &c., are explained in accordance with Newton's hypothesis; nor do I see how the evolution of definite quantities of heat during chemical reactions (*i.e.*, the transformation of certain amounts of atomic motion into molecular motion), and many other analogous phenomena, are accounted for by this "law of force" regulating the mutual action of atoms on one another. On this point I may be in error, if so, I am open to conviction, and will willingly recant my objection to the atomic hypothesis on this score when it is shown that the same hypothesis which accounts for the motions of celestial bodies will also account for those of ultimate atoms, the existence of such atoms being assumed.

Even then, however, I should still retain the conviction,

which I have elsewhere expressed, that in teaching the science of chemistry it is preferable, first, to enumerate the facts in language independent of any hypothesis, and then to enunciate the various hypotheses that have been and are held, showing how far each is in accordance or contradiction with the observed facts; rather than to mix up from the outset one particular hypothesis with the facts, so as finally to impress on the mind the manifestly erroneous conclusion that the facts have no existence apart from the hypothesis that more or less clearly explains them.

The President of the British Association states that the objectors to the atomic theory "are unconsciously guided by it." It may be within the memory of such of your readers as are interested in this matter, that some little controversy on this subject was carried on last year in the pages of the *Philosophical Magazine*. This ceased on my part from a conviction of the uselessness of continuing discussion with an antagonist who persistently ignored the main point at issue, *viz.*, the distinction between the meaning attached to the phrase "atomic theory" by Dr. Williamson and his disciples, and that applied to the term "atomic hypothesis" by myself; the former phrase being employed to indicate not merely what is commonly understood as a hypothesis, but also to connote a large number of purely experimental generalisations wholly distinct from the atomic hypothesis (as these words are understood by the majority of chemists) is in any way whatever, consciously or unconsciously, involved of necessity in the calculation (from experimental data and arbitrary conventions) of a formula (*i.e.*, a set of symbols indicating in brief certain physical and chemical properties and reactions), is a point that I am wholly unable to see; but, on the other hand, the following quotations (samples of many that might be given as illustrations) demonstrate to my thinking that the habit of mixing up the known and the unknown by using defective language which embodies both forms of idea when the former only should be referred to, is productive of contradictory statements and of unphilosophical modes of thought.

"The so-called Law of Multiple Proportions has no existence apart from the Atomic Theory." (Williamson, *Journ. Chem. Soc.*, 1869, p. 339.)

"The Law of Multiple Proportions, being founded on experimental facts, stands as a fixed bulwark of the science, which must for ever remain true; whereas the Atomic Theory, by which we now explain this great law, may possibly in time give place to one more perfectly suited to the explanation of new facts." (Roscoe, "Elementary Chemistry," 1st edition, p. 54.)

"This important law (of multiple proportions) which was first clearly established by Dalton, was explained by him by means of his atomic theory." (Miller, "Elements of Chemistry," vol. i., p. 15, 1st edition.)

"The atomic theory . . . is the very life of chemistry." (Williamson, *loc. cit.*, p. 365.)

Sir Benjamin Brodie "agreed with Dr. Odling when he said that the science of chemistry did not require or prove the atomic theory." (*Ibid.*, p. 440.)

It is scarcely necessary to point out that the statements of Dr. Williamson are diametrically opposed to the juxtaposed quotations; that the first statement is in opposition to the opinion of most other chemists; and that these discrepancies arise from the abnormal meaning attached to the term "atomic theory" by Dr. Williamson.

For the reasons above stated, I have no wish to re-open a controversy on this subject; but the way in which my name is referred to in the article alluded to causes me to request space for the insertion of the foregoing remarks, so as to correct any possible misapprehension as to the effect of the eloquent presidential address at Bradford on the opinions of those who object to view facts *solely* through the medium of preconceived notions, no matter how attractive or how useful when judiciously employed.

PROCEEDINGS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Annual Meeting, April 29th, 1873.

E. W. BINNEY, F.R.S., F.G.S., Vice-President, in the Chair.

THE following Report of the Council was read by one of the Secretaries:—

The Council have the satisfaction to report that a further improvement has taken place in the financial position of the Society, the Treasurer's account showing that the general balance on the 31st of March last was £407 18. 4d., against £340 os. 3d. on the 31st of March, 1872.

The number of ordinary members on the roll of the Society on the 1st of April, 1873, was 174, and 6 new members have since been elected; the losses are—Deaths, 4; resignations, 4; and defaulters, 3. The number on the roll on the 1st of April instant was, therefore, 169. The deceased members are John Francis, George Cliff Lowe, Samuel Emanuel Nelson, and Joseph Jordan.

Mr. George Cliff Lowe, whose death was the result of an accident in the United States, was known to many of our members for his general and accurate acquaintance with the natural sciences, but more particularly that of astronomy.

Possessing a love of knowledge for its own sake, and a comprehensiveness of mind to deal with other besides purely physical subjects, he took great interest in the leading philosophical questions of the present time, and his opinions were generally to be found on the side of progress. Although not a frequent contributor to the literature of science, Mr. Lowe had an acuteness of perception, combined with a degree of manipulative and artistic skill, which made his co-operation and judgment much valued and sought for by others.

We thus find Mr. Lowe's name associated with that of Professor F. C. Calvert, F.R.S., in a joint paper "On the Expansion of Metals and Alloys," published in the *Proceedings of the Royal Society*, vol. x., 1860. Mr. Lowe was also associated in business with our member Mr. Wilde as an electrical engineer, and suggested to him the plan of exciting a number of electro-magnetic machines by the current from one machine, instead of employing a separate exciting machine for each. With his philosophical attainments Mr. Lowe combined estimable moral qualities, the most conspicuous of which were the amiability of his character and the generosity of his disposition.

Mr. Joseph Jordan, F.R.C.S. Engl., was one of the oldest members of the Society, having been elected on the 19th of October, 1821. He was born in Manchester, and, with the exception of a short period when he was surgeon of the 1st Lancashire Militia, resided in Manchester all his life. He retired from active practice about nine years ago, when he was in the 76th year of his age. His name will be distinctly remembered as the founder of provincial medical schools. As early as 1814, he gave regular courses of lectures on anatomy, with demonstrations and dissections, to classes of medical pupils and students. He was the first provincial lecturer and teacher whose certificates were accepted and recognised by the examining bodies in London. The Apothecaries' Hall began to accept his certificates in 1817, and the College of Surgeons in 1821. In 1826 he built a medical school in Manchester at his own cost, and, besides its lecture hall, provided it with one of the most commodious and best-fitted dissecting-rooms in England, and transferred to it his own valuable museum, containing nearly 4000 anatomical specimens and morbid and other preparations. He subsequently placed this museum in the Manchester Royal School of Medicine. He devoted himself to the arduous duties of a

public lecturer for twenty years. On his retiring from the chair, a public dinner was given to him by his friends, in October, 1834, attended by almost every medical man of reputation in Manchester, and a handsome and valuable testimonial in silver plate was presented to him from his friends and pupils.

Mr. Jordan had further claims upon public regard as a large benefactor to suffering humanity by professional unpaid services. In his private practice, extending over more than fifty years, Mr. Jordan ever showed a special devotion to the relief of the sickness and suffering of the poor. His great professional skill, often unpaid, and even supplemented by a liberal purse, and that genuine kindness which ever doubles the value of a gift, won for him the blessings of thousands. Nor was his philanthropy less conspicuous in official positions. About 1810, he aided largely in founding the Lock Hospital for unfortunate women, of which he was the surgeon or consulting surgeon till he finally retired from practice. He was always a steady benefactor to the institution, in wise counsel and liberal donations. In 1835, he was appointed an honorary medical officer of the Royal Infirmary, and long filled the honourable position of its senior surgeon with the highest credit to himself and with great benefit to the institution and the community at large. Within its walls he often performed some of the greater, as well as the more delicate, operations of surgery; his remarkable nerve and steadiness and precision of hand admirably qualifying him for these duties. He invented a most beautiful little lamp to obtain a magnified view of the membrane tympani and other organs, for which the Society of Arts awarded their silver medal. His clinical lectures in the hospital wards always attracted a large and attentive following of the pupils and students, and a few years ago a very numerous signed testimonial was presented to him by the pupils of the Royal Infirmary for these lectures. He was a most eloquent and interesting lecturer, and his great and long experience enabled him to illustrate his lectures with cases bearing upon the subject, which rivetted the attention and increased the knowledge of his hearers.

Mr. Jordan was a valued contributor to medical science by a new method of treating false joints. A difficult class of surgical cases is presented when the fractured surfaces of bone refuse to reunite, or else unite so badly as to cause great suffering and even loss of the use of a limb. For the cure of these so-called "false joints," and the effecting of a speedy, safe, and satisfactory reunion of the fractured bones, Mr. Jordan, in the year 1854, invented and applied a new and exceedingly simple mode of treatment. His plan was recognised not only by his professional brethren in Manchester, but in June, 1856, the eminent Paris surgeon, Professor Nelaton, in a public lecture to his class, described the method as "a happy innovation, and one capable of receiving numerous applications." The priority of Mr. Jordan's claim to this invention was beyond doubt. Finding, however, that a French surgeon was introducing the method as his own, Mr. Jordan proceeded to Paris in 1860, where he published in French a treatise, illustrated with three plates, entitled "Traitement des Pseudarthroses par l'Autoplastie Periostique," which not only effectually extinguished any rival claim, but comprised a full and clear exposition of the mode of treatment in all its successive stages, and gave to the author a European reputation.

It was at one time proposed that some mark of her Majesty's favour should be solicited by Mr. Jordan's friends, to honour one who had conferred so much credit upon his profession in Manchester, and so much advantage upon the community at large; but the modesty of the veteran self-sacrificing surgeon shrunk from this distinction, and at his instance the movement was stopped.

In the last annual report it was stated, with reference to the benefaction which the late Natural History Society provided for the promotion of the study of natural history in Manchester, under the guardianship of the Literary and Philosophical Society, that the Owens College would at once proceed to endeavour to sell the Peter Street site, to

be delivered up in June, 1873, for money or for rent, as may seem best. In the latter case, it had been agreed between the Commissioners and the College that the College should pay £60 per annum as interest at 4 per cent on £1500 until the principal shall have been paid over to the Society. The Council have now to report that the Peter Street site has not yet been sold, but on the 20th of November last a letter was addressed by Mr. Darbshire to Mr. H. A. Hurst, the treasurer of the Microscopical and Natural History Section, stating that, by an arrangement made on that day between the Commissioners of the Peter Street Museum and the Owens College, the Museum Trust in the hands of the College will pay to the Philosophical Society, for the present, interest upon the sum of £1500 at 4 per cent from that date. The first half-yearly payment will therefore become due on the 20th of May next.

At a meeting of the Council held on the 7th of January last, a committee was appointed to consider and report upon the desirability of incorporating the Society, and of acceding to an application of the Manchester Geological Society for permission to hold its meetings and keep its library within this society's buildings. Resolutions embodying the recommendations of this committee will be submitted for the approval of the members of the Society.

In May of last year, Dr. R. Angus Smith, F.R.S., a vice-president of this Society, attended on behalf of the Society the centenary celebration of the foundation of the Royal Academy of Sciences of Belgium, and a medal has this day been received commemorative of this interesting event.

The following gentlemen were elected officers of the Society and members of the Council for the ensuing year:—

President—James Prescott Joule, LL.D., F.R.S., F.C.S., &c.

Vice-Presidents—Edward William Binney, F.R.S., F.G.S.; Edward Schunck, Ph.D., F.R.S., F.C.S.; Robert Angus Smith, Ph.D., F.R.S., F.C.S.; Rev. William Gaskell, M.A.

Secretaries—Henry Enfield Roscoe, B.A., Ph.D., F.R.S.; Joseph Baxendell, F.R.A.S.

Treasurer—Thomas Carrick.

Librarian—Charles Bailey.

Of the Council—Robert Dukinfield Darbshire, B.A., F.G.S.; Osborne Reynolds, M.A.; William Boyd Dawkins, M.A., F.R.S., F.G.S.; Balfour Stewart, LL.D., F.R.S.; Alfred Brothers, F.R.A.S.; Rev. Brooke Herford.

MICROSCOPICAL AND NATURAL HISTORY SECTION.

April 21st, 1873.

Professor W. C. WILLIAMSON, F.R.S., President of the Section, in the Chair.

MR. JOHN BARROW read a paper "On the Use of Naphthalin in Section Cutting."

I wish to bring before the notice of the members, and those microscopists who are interested in cutting sections of soft or delicate tissues, the use of naphthalin as a support for such tissues in the section cutter.

The advantages obtained by the use of naphthalin over wax and other bodies recommended for this purpose are—A low fusing-point, absence of contraction in the cutter, very little injury to the edge of the knife, and very ready solubility after cutting in benzol or spirit, so that the substance is removed at once from the section without injury.

Naphthalin is a body not very generally known outside the works of the tar-distiller or colour-maker, so that possibly some of the Members may not be able to obtain samples readily, but I shall have pleasure in supplying it to any of our own members.

Professor WILLIAMSON recommended an admixture of wax and oil with the naphthalin, and stated that the knife cuts better with this addition; he also exhibited some extremely beautiful longitudinal and cross sections made in this way.

CORRESPONDENCE.

PHOSPHATES OF IRON AND ALUMINA IN MANURES.

To the Editor of the Chemical News.

SIR,—To all farmers and agricultural chemists the real value of soluble and precipitated phosphates of iron and alumina, as compared with that of the corresponding lime compounds, is a question of very great interest. The various native phosphates contain more or less ferric oxide and alumina, free or combined, part of which, during the superphosphating process, is rendered soluble; and the proportion thus dissolved is not inconsiderable when, as at present, the high prices of raw material and labour necessitate the use of as much acid as possible consistent with dryness, so as to leave little insoluble phosphate. The ferric and aluminic oxides are thus more apt to be dissolved along with the phosphates and carbonate of lime.

It is admitted very generally that precipitated phosphate of lime is equal in real value to the soluble form of that compound; in fact, that as soils contain carbonate and humate of lime, the soluble monocalcic phosphate is transformed almost immediately into the very sparingly soluble dicalcic salt. More readily so will the soluble monoferric phosphate revert to the insoluble form under the same circumstances. Whether the soluble iron in manures exists in combination with phosphoric or sulphuric acid is of no moment, as the lime in the soils will so act on monocalcic phosphate and sulphate of iron as to give insoluble ferric phosphate.

Is this precipitated ferric and aluminic phosphate capable of ready assimilation in the soil? Many chemists will point to its comparative insolubility in carbonic acid water as supplying a negative answer, but I am not quite satisfied with this conclusion. In the soil there are many substances besides carbonic acid playing a part in the dissolving of insoluble plant food, such as carbonates of lime and magnesia, alkaline chlorides and sulphates, ammoniacal salts, hydrated silicates, humus, &c. It would be interesting to know whether any experiments have been made to test the point. It is well known that under the influence of water containing carbonic acid all silicates are more or less readily decomposed, the bases going into solution as carbonates and soluble silicates. According to Zöller, soil drainage contains 9.34 to 17.46 grs. silicic acid per 1,000,000 grs. resulting from such action. Is it at all unlikely, might it be asked, that between these products and ferric and aluminic phosphates such a decomposition might arise as would result in the formation of a soluble phosphate? Alkaline silicates decompose these phosphates so completely as to be employed in the quantitative separation of the phosphoric acid from its base, the acid being rendered soluble. In the soil drainage we have, if not alkaline silicates, silicic acid and alkaline and earthy carbonates. Might we not have, in short, silicic acid and a bicarbonate so acting on phosphate of iron as to form a soluble phosphate and silicate of iron? Besides, it is by no means unreasonable to suppose that all soluble phosphates of lime and magnesia applied to the soil become very soon converted into ferric and aluminic phosphates. All fertile soils contain a practically unlimited quantity of active ferric and aluminic hydrates, and analyses of drain-water from various soils show quantities in solution varying from 1.32 to 8.26 parts per million. Here we have the conditions necessary for the conversion—an almost unlimited quantity of the precipitant, and a liquid able to dissolve it.

You have readers in all parts of the country, indeed on both sides of the Atlantic, to whom this question is one of great practical importance, and I shall be amply rewarded for my pains if these remarks should originate a thorough and exhaustive discussion of the subject in your columns.—I am, &c.,

TRUTH SEEKER.

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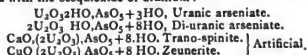
PRELIMINARY INVESTIGATION OF THE FLUORESCENT AND ABSORPTIVE SPECTRA OF THE URANIUM SALTS.*

By HENRY MORTON, Ph.D.,
and H. CARRINGTON BOLTON Ph.D.,

(Continued from p. 167).

Arsenates of Uranium.

We have examined the following compounds of arsenic acid with the sesquioxide of uranium:—



From this—which must, however, be regarded as quite too limited a range of experiment for so extensive a deduction—it would seem as if the compound of uranic oxide with arsenic acid were peculiarly fixed and inflexible in the relations which we have now under review. We obtain from these four compounds, at all events, but one spectrum of fluorescence and one of absorption. The three first-named fluorese with various degrees of brightness, but with the same bands; which are, moreover, very characteristic as compared with those of other salts. Zeunerite shows no fluorescence.

The bands of these spectra have the appearance of flat narrow ribbons, with little of that gradation on the edges which is observable with the other spectra. They appear as if displayed against a partially illuminated back-ground whose uniform tint is broken by a shade on the more refrangible side of each band. 1 of Fig. 8 will give some idea of this.

FIG. 8.

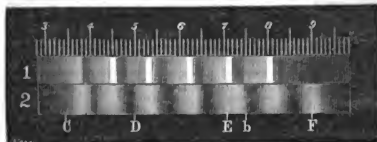
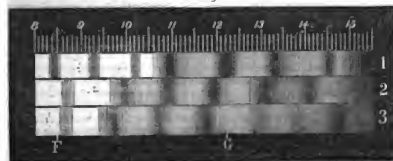


FIG. 9.



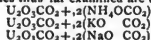
Absorption-Bands.—All four of the substances named above give the same absorption spectrum, which is distinguished by the same characteristic noticed in the fluor-

* Communicated by President Morton.

escent spectrum of these salts, namely, the presence of narrow well-defined flat bands. Above 110, where the general absorption begins, the bands not only seem darker, but more blended on their edges. In Fig. 9 the first spectrum will indicate this.

Uranic Carbonates.

Carbonate of uranium, *per se*, does not exist, but in combination with the alkaline carbonates forms finely crystallised, not very soluble double salts. The ammonium salt, $\text{U}_2\text{O}_3 \cdot \text{CO}_2 + 2(\text{NH}_4\text{O} \cdot \text{CO}_2)$, has been mentioned; the corresponding compounds of sodium and potassium are obtained by dissolving the uranates of these bases in warm strong solutions of their respective carbonates. The uranic carbonates thus far examined are the following:—



They all fluorese faintly, their relative brightness being in this order—Ammonio-, sodio-, and potassio-salt, in decreasing intensity. In character the spectra of these salts very much resemble those of the less brilliant double acetates, though they have a stronger light in a narrow line near the more refrangible edge of each band. The positions of the bands of these three salts were not distinguishably different with the methods employed in this examination, and may be seen from 2 in Fig. 8.

The absorption spectra of the ammonio- and potassio-salts are indistinguishable from each other, and from the solutions of any of the three salts; 2 in Fig. 9 shows the absorption spectrum of the sodio-salt, and 3 that of the other salts and of the solutions. The absorption-bands of all these carbonates are remarkably distinct and strong. Stokes first drew attention to them, and suggested their use as a means of recognition (*Phil. Trans.*, 1851, Part II., p. 522).

The thing that strikes the attention at once on seeing the absorption spectrum of the carbonates is the prominence of the three strong black bands at about 105, 115, and 125, which stand out clearly on a light background, the general absorption which commences about this making the higher bands far less prominent.

Oxychlorides.

The salts of this class which we have thus far examined are the following:—

The uranic oxychloride, $\text{U}_2\text{O}_3\text{Cl} + \text{HO}$, in various states of hydration not yet determined.

Ammonio-uranic oxychloride,—



Potassio-uranic oxychloride,—



We have not as yet succeeded in obtaining other double salts of this class. The method of preparation is simply to mix the respective chlorides in atomic proportions with water and excess of hydrochloric acid, and place in a desiccator. Sometimes, however, we have found that under these conditions the salts would crystallise out separately, again and again, without forming a compound. It, however, occurred to us that, if a ready-formed crystal of the double salt were placed in such a solution, it would act as a determining centre, around which like material would group itself. In all cases where this plan has since been tried, it has succeeded admirably. Thus, a mixture of ammonio and uranic oxychlorides, which had been standing for months without forming a particle of double salt, yielded a large crop of crystals within twenty-four hours after the addition of a few ready-formed crystals, and

then continued to produce nothing but the double salt. **Uranic Oxychloride,** $\text{U}_2\text{O}_3\text{Cl} + \text{HO}$.—A neutral solution of the above in a desiccator forms an opaque yellow mass having a moderate fluorescence, and yielding the spectrum

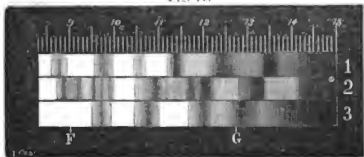
shown in 2 of Fig. 10. This is the substance generally known as the uranic oxychloride, or, in commerce, as uranic chloride. The general character of its spectrum is that which may be regarded as normal to uranic salts—a series of rounded bands terminating most abruptly on the upper edge. In transmitted light, it produces a very marked absorption spectrum, which is shown at 1 of Fig. 11. When the neutral oxychloride is dissolved, it forms a rich orange solution, which has a very great general absorption, and shows some bands; it is almost devoid of fluorescence. The addition of a little hydrochloric acid greatly reduces its colour, and, as with the uranic acetate, clears up its spectrum, which then shows the bands exhibited in 3 of Fig. 11. These same bands are shown by the solutions of the ammonio and potassio double salt, and lead us to conclude that the double chlorides, like the double acetates, only exist as such in the solid or crystallised state. If the uranic oxychloride is allowed to crystallise from a very acid solution in a desiccator, it will form a transparent yellow mass, whose spectrum will be of the duplex character indicated in 4 of Fig. 1. This we have little doubt indicates the presence of two hydrates, but it is curious to observe how regularly this spectrum appears whenever the uranic oxychloride crystallises from an acid solution. We encountered it constantly in our unsuccessful attempts to form double salts.

Fig. 10.



Oxychlorides.

Fig. 11.



Oxychlorides.

Ammonio-Uranic Oxychloride, $U_2O_3Cl + NH_4Cl + 2HO$.—Though this substance is often so difficult to form, as has been already stated, yet, once formed, if there is a slight excess of hydrochloric acid present, it may be fused, and will crystallise instantly on cooling. If kept in a fused state until a partial decomposition has taken place, an opaque yellow body is formed, which fluoresces very brightly, and yields a continuous spectrum. The normal salt is, perhaps, one of the most beautifully fluorescent in the entire series, and it yields a spectrum equally remarkable. This is represented at 1 of Fig. 10. Each band, as we may say, is here made up of from three to five narrow stripes variously shaded, and this, combined with their rich colouring produces an effect of wonderful beauty. The absorption spectrum of this salt, also of a somewhat composite character, is represented in 2 of Fig. 11.

Potassio-Uranic Oxychloride, $U_2O_3Cl + KCl + 2HO$.—This salt, in all its fluorescent relations, so closely resembles the ammonio salt just described, that it is only necessary to note this fact, and say that all its bands are a very little raised in the spectrum, but this difference is too small to be represented in a cut on the scale here employed.

(To be continued.)

ON THE

SPONTANEOUS ASCENT OF LIQUIDS IN VERY NARROW SPACES.

M. DECHARME, having a short time since studied the ascent of a large number of liquids in capillary tubes, has recently experimented on the ascent of these liquids in porous paper, with the view of ascertaining whether they ranked in the same order, in this case, as regards height and velocity of ascent. The general results are as follows:—

(1). The ascending movement of liquids in strips of blotting-paper, compared with that in capillary tubes, presents essential differences, as well as numerous similarities. The curves obtained in both cases resemble each other in being sensibly divergent from parabolas, and tending, in the latter part, especially to the hyperbola; but in the blotting-paper the phenomenon is more complex than in the tubes, first from the influence of the hygrometric state of the air, and next because there is sometimes dialysis as well as capillarity.

(2). Each liquid has a velocity of ascent proper to it (papers of constant size being used in each case, and all other conditions being the same). The strips used were 15 or 30 m.m. in breadth, and all from the same sheet.

(3). For different liquids, in the same conditions, the velocities of ascent are not in direct proportion to the height ultimately reached. Thus non-volatile substances, as concentrated acid or saline solutions, and substances largely absorbent of water, sometimes rise slowly; but their movement may continue for days, or even for weeks.

(4). The velocity is, moreover, neither in inverse proportion to the total duration of the movement, nor simply proportional to the density of the liquid. The law depends on other elements, such as temperature and hygrometric state. The annexed curves illustrate these statements.

(5). With capillary tubes, only one liquid was met with which had a velocity constantly superior to that of pure water; it was an aqueous solution of chlorhydrate of ammonia. With the papers, more than forty liquids have been found in a total of 207 (i.e., about a fifth), having both a velocity and a final height superior to that of water. Among these may be cited chlorhydric, nitric, oxalic, tartaric, and citric acids; chlorides of calcium, zinc, and lead; chlorhydrate of ammonia; nitrate, bichromate, oxalate, urate, cyanurate, and oxalurate of ammonia; iodide and bromide of ammonium; chlorate, perchlorate, persulphate, and binoxalate of potash; sulphocyanide, bromide, and cyano-ferride of potassium; sulphate of soda, &c.

(6). For the same liquid, all other conditions equal, the velocity and the capillary height increase with the breadth of the paper.

(7). For the same liquid, and the same breadth of paper, but for strips of a thickness double, triple, quadruple, &c. (multiple strips formed by superposition of several equal strips), the capillary velocity, and the duration of the ascent increase very sensibly with the thickness.

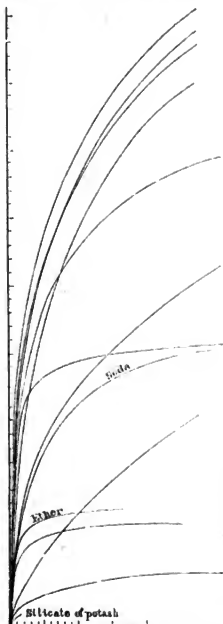
(8). A slight pressure exerted on these multiple strips, better insuring their contact, favours the ascending movement; but, beyond a certain limit of strength, pressure on a sufficiently extended surface diminishes the velocity of ascent, and may even arrest the movement altogether.

(9). The inclination of the paper has a positive influence on the velocity, the length of course run by the liquid, and the total duration of the movement. In every case there is not a proportionality between the heights or the velocities observed and the variable elements, breadth and thickness of paper, pressure, &c.

(10). For all liquids, the velocity of ascent increases with the temperature. Still, if at the beginning of the movement such increase appears, it is presently counterbalanced and ruled by the evaporation, which retards, and

at length completely arrests, the ascent of the liquid, especially where the latter is somewhat volatile. The influence of temperature varies much with the nature of the liquids.

(11). The hygrometric state of the air plays an important part. The more humid the air, comparatively, the greater the velocity and the duration of ascent, and the height finally reached.



What is here said about water applies to many other liquids, especially to those which are very volatile, or to solutions of very hygrometric substances.

Strips soaked, by capillarity, with the following substances, have remained humid during several months in summer:—

Cyanide of potassium.	Nitrate of uranium.
Sulphocyanide of potassium.	“ silver.
“ ammonium.	Pentachloride of potassium.
Chloride of ammonium.	Hyposulphite of potassium.
“ calcium.	Hypophosphite “
“ magnesium.	Phosphite of ammonia.
“ zinc.	“ potash.
Sesquichloride of chromium.	Sulphite of potash.
Bromide of lime.	Bisulphite of potash.
Nitrate of lime.	Acetate of potash.
“ copper.	Caustic potash.

The following example gives an idea of the influence of degree of humidity of the air on the ascent of water in strips of 15 m.m. breadth:—

		Time (in hours).											
		1.	2.	3.	4.	5.	10.	20.	40.	51.			
Heights in m.m.)	Air pretty dry..	81	104	125	132	135	137	(End of movement.)					
	Air very humid	135	166	189	195	197	198	199	204	214	228	232	

Chlorhydric and nitric acids and half diluted sulphuric acid have remained in the papers six or seven days, the temperature being 15° to 20°. Chloride of gold completely blackened the strip, which soon fell to pieces, all remaining humid, however, a long time. The strip soaked with sulphocyanide of potassium remained humid throughout its length, 45 centimetres, during more than six months, beyond which the experiment did not continue.

(12). Another cause often comes to act as an obstacle to the ascent of saline solutions, viz., the crystallisation which takes place in the paper from evaporation of the liquid. An example of this is chlorhydrate of ammonia, which, in moist air and moderate temperature, shows at first a velocity equal, and even sometimes superior, to that of half diluted chlorhydric acid, which has generally the maximum velocity of ascent; but, if the surrounding air is pretty dry, the salt in a day or two crystallises in layers, more or less thick, in the middle part of the strip, thus retarding the movement, and at length arresting it.

This applies also to saturated solutions of crystallisable hygrometric substances, which, without having the velocity of chlorhydrate of ammonia, show similar variations.

It results, from these various disturbing influences, that the ascending movement of a liquid in a strip of blotting-paper may be modified by external circumstances in such a way that, for a certain number of liquids, the order of velocities of ascent, that of duration, and that of final height, may be reversed.

En resumé, the little volatile, very soluble, very hygrometric liquids, which do not crystallise in the blotting-paper, are those which rise the highest, if not the most quickly.

The order of capillary heights, that of velocity, and that of total duration, may therefore be, and in fact are, quite different for the same liquids experimented on successively in capillary tubes and in strips of blotting-paper. The laws governing the two phenomena are different.

It appears, from experiments made on a great number of liquids, differing much both as to chemical composition and physical properties, that with capillary tubes the aqueous solution of chlorhydrate of ammonia and water are in the first rank for velocity and final height; while in strips of blotting-paper these two substances are surpassed in both respects; in the second, especially, by dilute acids, alkalis, and several potassic, sodic, calcic solutions, &c. Further, in strips of paper, chlorhydric acid has the greatest velocity, and generally reaches the maximum height. Silicate of potash, which, with capillary tubes, stood between glycerin and olive oil, is here at the very bottom of the scale; its movement is almost nil; it only, indeed, reaches about 4 m.m. height in the blotting-paper.

From the preceding results relating to ascent of liquids in multiple strips, the following inferences are drawn:—

(1). They explain how liquids, water in particular, with matter held by it in solution, rises to such great height in porous building materials of a house, where the foundations rest in a damp soil. It is not an extraordinary thing that, after some time, the presence of moisture and saline matters should be detected, not only on the ground floor, but on the first, and even the second; the liquid ascending in capillary substances of great thickness, and not subject to much evaporation.

(2). The vessels of plants, with their numerous anastomoses, and the permeability of the tissues composing them, are rather comparable to the superposed strips of blotting-paper than to capillary tubes. It is not surprising that the greater part of the saline solutions containing solids fit for their nutrition rise in the vessels to heights much greater than water would do, and also more quickly.

It is not necessary, then, to have recourse to an extreme fineness of vessels, to explain the ascent of liquids in the tissues of plants. It is sufficient to remark that the saline solutions which naturally exist in the soil rise higher than pure water; sometimes to double the height, *e.g.*, the following salts:—Nitrate, sulphate, carbonate, bicarbonate of potash, nitrate of lime, carbonate of soda, chlorides of potassium and of sodium.

A. B. M.

THEORY AS TO THE FORMATION AND PROPERTIES OF OZONE.

By R. LAMONT.

WHEN phosphorus is allowed to oxidise in air, or oxygen gas, phosphorous pentoxide and ozone result. An atom of oxygen cannot exist in the free state, but a molecule can, which in this case consists of two atoms (O-O). Phosphorous pentoxide consists of a molecule of phosphorus combined with two molecules + an atom of oxygen. When phosphorus is left to oxidise in oxygen, the molecule of phosphorus combines with two molecules of oxygen, but, this not being sufficient to form the pentoxide, it must have another atom of oxygen, which it can only get by splitting up a molecule of oxygen—one of the resulting atoms combining with the phosphorus, the other atom going to a molecule of oxygen to form ozone (O-O-O). If the ozone which has been formed is allowed to remain in contact with the phosphorus, it is decomposed thus— $P_2 + (O-O-O) + (O-O-O) + (O-O-O) = P_2O_5 + (O-O) + (O-O)$. The powerful oxidising properties of ozone may be accounted for by supposing that the three atoms of oxygen are so loosely combined that, when it comes in contact with an oxidisable substance, one of the atoms combines with this substance, the other two going to form a molecule of oxygen.

ANALYSIS OF GREAT SALT LAKE WATER.

By H. BASSETT.

HAVING a small quantity of the above water placed at my disposal by Dr. W. Marcet, F.R.S., who collected it himself last August, I thought an analysis might be of interest, especially as I have not found any account of it in books of reference. The water has a slight alkaline reaction, and a specific gravity of 1.102 at 17°.

Total solid residue, in 100 parts, by weight = 13.67.

In 100 Parts by Weight.

Chlorine	7.36
SO ₄	0.88
Sodium	3.83
Potassium	0.99
Calcium	0.06
Magnesium	0.30

13.42

ON THE ENERGIES OF THE IMPONDERABLES, WITH SPECIAL REFERENCE TO THE MEASUREMENT AND UTILISATION OF THEM.*

By the Rev. ARTHUR RIGG, M.A.

(Continued from page 224).

LET us now pass on to the mode of obtaining electricity from chemical action. Before doing so a phenomenon should be noticed, which disturbs results very seriously, and which is, at present, not understood. Here is some copper wire, covered with cotton, coiled from end to end, say five or six times along this large bobbin of wood.

Within the bobbin is a larger hole than usual. The two ends of this wire so coiled are connected with the reflecting galvanometer. The reflected light from this lamp is now visible and stationary upon the screen. You are aware that motion of that reflected speck of light will be the consequence of electricity passing through the coils of the galvanometer. Now, observe that, without either chemical or physical agency acting upon or in contact with the wire, we shall obtain a manifestation of electrical disturbance within the copper wire. Let the end of this steel magnet be introduced within the bobbin: you see that the speck of light immediately moves. Except in this manner, copper does not manifest electrical properties. Again, if the other end of the steel magnet be brought within the bobbin, you see the speck of the galvanometer moves in an opposite direction. Thus may be shown one form of electrical induction.

Now, with that phenomenon we are perplexed. This property of induction manifests itself at times and in ways of which we know nothing. For example, if a copper wire were laid upon this floor, and another copper wire were laid parallel to it on the floor below; and if any current of electricity passed through the wire on this floor, the one below would answer to it, although there was not any apparent contact or communication between them.

The laws which govern such electrical manifestations as these are very partially understood, and therefore the measurements of the results of these laws are for general use almost valueless. We must, however, for the present assume that the nature of the phenomena of electrical induction is clear.

The next stage in obtaining electricity is by means of what is called a galvanic cell. Such a cell usually consists of two different metals and one or two liquids. Whatever may be the arrangement, the electricity developed may be estimated by the intensity of chemical affinity during the process and at the time of the measurement. But the whole of this question of chemical affinity must now be assumed, and some of the affinities explained in the last lecture are probably the chemical affinities operating in this cell. A chemical action takes place upon a square inch of one plate, and it is met by an action upon a square inch of the other; therefore, on every square inch an action is produced. Between the two plates there is something (say the liquid) which causes the action; it is, in fact, the presence of this liquid which calls the chemical affinities into play.

A word must now be introduced which will often occur during the lecture, and it is one which performs an important part in the measurement of electricity of the character which men utilise, *i.e.*, resistance. Indeed, this resistance to the free passage of an electric current is now our chief business. Whilst the size of the plates in these cells is increased, the resistance to the free course of the manifested electricity is not decreased. Thus, for instance, from a square inch of one plate there is a current of electricity meeting or co-operating with that developed from a square inch of the opposite plate. Whatever may be the energy of the chemical affinity upon one square inch, it is met by the energy of the chemical affinity upon the opposite square inch of the other, and that energy has to overcome the resistance of the liquid between them. Now, then, assume that each of these plates is enlarged by the addition of another square inch. This introduces an additional quantity of liquid, and we have to overcome the resistance of this liquid. The difficulty of overcoming the resistance of the intervening liquid is such that, however much we multiply the number of square inches, we also introduce more liquid, and, by so doing, add further electrical resistance. Hence, however large may be the plates, we do not overcome the resistance more easily. That led to the contrivance of thus coupling-up in what is called "a series" in the form you see here, that which is familiar under the name of a cell-battery.

It may perhaps make clear what is a difficulty to many minds, if an attempt be made to explain how it is that an

* The Cantor Lectures, delivered before the Society of Arts.

electrical current which passes when cells are coupled-up "in series," that is, one after the other, is more intense than when they are combined as one large single cell.

Supposing these two plates, each 1 square inch in area, were the only two concerned, therefore there would be a certain resistance to be overcome. The chemical affinity of one such combination not only overcomes that resistance, but leaves a surplus of electricity, which surplus is said to run along the outside wire, and may produce what we call a telegraphic dispatch. Now, suppose that, in addition to those two plates, there are two others of the same size and material in a cell behind them. Between these second plates there is also a resistance similar to that between the first two. Those two second plates, however, also produce a surplus. Now, as that surplus passes over, it continues its way through the previous plates and wire, and the consequence is that, when once the resistance of its own cell has been overcome, the surplus electricity can pass through the other cells without any resistance, and, therefore, we are enabled to add the surplus of one cell to the surplus of the next, and so on. Hence, when combined in the form in which they are combined in this battery, we are manifestly enabled to pass along the connecting wire successive equal amounts of electricities, and these, flowing so very closely behind each other, produce an effect upon any resistance similar to that produced upon a slab of marble or of glass by the forcible driving against it of small grains of sand in a continuous stream. These grains penetrate, and, as it were, bore holes even in hardened steel; so these successive electricities are, as it were, continuous, and thereby overcome great resistances. It may, in connection with this, be remarked that, perhaps, in some such way as now described, the mighty energies of affinity may be accomplished by this clashing of millions upon millions of atoms and molecules. This may explain how and why it is that these cells thus arranged "in series" are under certain circumstances more effective than when the same amount of liquid and metallic elements operate as one cell only.

Electricity thus, or by other means at our disposal, is now to be measured. Two things are especially before us now. One to make clear how this measurement is made; the other to endeavour to make clear how the resistance of various bodies, be they wires or liquids, is also measured.

This electricity is measured in a very simple way. All the apparatus is here, but as it would take too long to show experiments in detail, perhaps you will kindly accept a statement of facts instead of a visible reproduction of them. In these cells is being produced a quantity of electricity, which is to be measured, much as sugar is measured by the pound, or liquids by the quart. The way it is measured is either by the chemical decompositions that it can produce, or by the amount of heat it can develop, or by other means, as, for instance, its effect upon the magnet in a given time.

This seems a convenient opportunity for directing attention to a galvanometer, which is arranged upon a plan by which is shown the amount of decomposition effected by the current indicated by the place of a needle on the dial. The gentleman who designed it had in view only a manufacturer's requirements. The measurement effected by such a galvanometer is not of that character with which this lecture is to be concerned, and therefore further reference to this particular one is not requisite.

To consider a mode of measurement we must recur to those elements—mass, space, and time. The apparatus on which my hand now rests consists of a wooden ring, about 10 inches in diameter, having coils of copper wire round it. Within this circular box with a glass top is a small magnetised steel needle. Now, the small steel needle assumes a certain position in consequence of the influence of terrestrial magnetism. Such an influence as this is not unlike a stream of water in a brook upon a short stick, one end of which is tied to a stake by a

string. So long as the stream flows steadily past the stick it is retained in the same position. Let a disturbance take place in the evenly flowing water, and the stick will no longer retain either steadiness or direction. Suppose, now, that this needle is retained in a certain direction by the influence of what we may call the stream of terrestrial electricity flowing through the atmosphere of this room. (That such a stream is so flowing through the atmosphere shall be made apparent presently.) From these four cells of a galvanic battery a current of electricity may be caused to pass along the wire which surrounds this wooden ring. The arrangements are made, and such a current is now passing. What is the consequence? The even flow of that which retained the needle is disturbed, and the needle answers as the stick in the water would have done to the disturbing cause. Clearly the nature and extent of the invisible disturbance may be estimated—indeed measured—by the motions of the visible needle, just as a new position assumed by the stick would measure the disturbing influence on the stream.

The promise to let you have proof that there are currents of electricity passing through the atmosphere of this room may now be redeemed. Here is a circular wooden ring, with wire round it as before. You may notice that it can be turned as a looking-glass in its frame. The ends of the wire coiled round it are now connected with the wires of the galvanometer, the mirror of which reflects that speck of light on the screen. The looking-glass mounted ring is placed in reference to the (so-called) current of electricity always passing through the atmosphere, that were there a glass in the frame the current would beat upon that glass. If the frame be turned one-fourth round, then the current will pass parallel to the face of the frame. Or thus:—If the frame of the wire-enclosed ring be placed parallel to the direction of this magnetised needle, then the current of electricity through the atmosphere of this room is passing parallel to the ring. To move it, therefore, from this position to one at right angles to it, it is clear that the circumferential wire must, as it were, cut the stream of electricity, if there be one. Now, so cutting it, there will be a disturbance in the electrical condition of the wire, which may be manifested by a motion of that speck of light. Observe now, that every motion of the frame causes a motion in the needle of that galvanometer, which is placed on a stand far removed from the table on which the motion of the frame takes place.

The two experiments now made may satisfy you:—(1). That there is what, for want of another name, we may call a current of electricity passing through the air; (2) that disturbance of the uniform quiet flow of this current may be caused; (3) that this needle is sensitive to such a disturbance; and (4) you will perhaps accept my word for that which time alone prevents being illustrated, viz., that the amount of this disturbance may be measured by the needle—that is to say, the greater the disturbance the further will the needle be moved from its original position.

It will be obvious to all that the amount of motion in the needle for any given disturbance will depend upon its sensitiveness. Hence, two needles may or may not move equally from the same cause. A mode of measurement, therefore, which depends upon an artisan's capability to make either unit jars or needles equally sensitive cannot be one to be much relied upon. There is, however, a relationship between the motion of the needle and a totally different mode of absolute measurement of the quantity of electricity that may pass in a unit of time, which solves the difficulty now expressed.

The usual apparatus for the decomposition of water by an electrical current is standing here. It is in consequence of completing the wire circuit from this combination of four cells that decomposition takes place. The bubbles are rising regularly and rapidly. Patient

and watchful experimenters have established this, viz., the amount of water thus separated into its constituent elements of oxygen and hydrogen is always in exact proportion to the quantity of electricity that passes. If, then, it were convenient to be thus always decomposing water, a measure might be had. Thanks, however, to the mathematician, we have a much more simple mode of gaining this knowledge.

Suppose one end of the wire from these four cells is connected with the decomposing apparatus—this apparatus connected to the ring already explained—then from the ring to the other end wire of the cells. With such an arrangement observations can be made both on the decomposing apparatus and the deflections of the needle, when each is under the influence of the same current. If the quantity of electricity in the circuit varies, the amount of gas produced and the position of the needle vary also. These have been so frequently observed, that by looking at the needle the mathematician could always tell the amount of gas obtained; in fact, he could lay down a very simple rule for guidance. The application of this rule enables a person at all times to state what quantity of electricity is passing, even though he look to the needle only.

An arithmetical illustration may make this clear. Suppose that in one minute these gases, which may be seen coursing up the tube, filled a space in the tube marked to cubic inches—observe where the needle pointed. Let us assume that it is pointing to 45°. Suppose on another and future occasion the needle is observed to point to 60°, now, either from memory or from tables, we find that the tangent of 60° is entered as 1.73. Then, if ten be multiplied by 1.73, the result would be that 17.3 cubic inches of gases might be evolved. As there are in chemistry laws connecting the composition of bodies, such a result as this would enable a manufacturer to know how much silver, for example, this current of electricity would cause to be deposited in any fixed space of time. Thus may be measured the quantity of electricity passing in a unit of time.

But the deposition of gold and silver or other metals is not the only utilisation of electricity, and as other results of a very different kind are obtained from this "imponderable," it is time to turn to illustrations of another form.

(To be continued.)

performed by these medical analysts since the Ad. came into force are so few and far between, that the blunders committed must necessarily be likewise small and few in number.

Altogether, the Adulteration Ad. does not seem to be carried out in the spirit it demands. In many places there are no analysts at all, and the electing bodies do not even intend that there should be any. In Lancashire there are, I believe, only four appointments filled, viz., those of Liverpool, Manchester, Salford, and Bolton, while all the numerous other towns and thickly populated districts are entirely without analytical supervision. It is a pity that such a good movement should be so imperfectly followed up.—I am, &c.,

RIA.

Nov. 2, 1873.

PUBLIC ANALYSTS FOR STAFFORDSHIRE.

To the Editor of the Chemical News.

SIR,—Under the head of "Miscellaneous," in your impression of last week, it is stated that Mr. W. L. Scott has been appointed Analyst under the Adulteration Ad. for Derbyshire and Staffordshire. This requires slight correction in case of the latter county; for, although Mr. Scott is Public Analyst for North Staffordshire, I hold the appointment for the Southern Division, as well as for this borough.—I am, &c.,

E. W. T. JONES.

Borough Analyst's Laboratory,
10, Victoria Street, Wolverhampton.
November 1, 1873.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopaedic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, September 29, 1873.

Action of Gases in Coagulation of Albumen.—MM. Mathieu and Urbain.—When the gases dissolved in serum of blood are completely extracted, there is obtained an albuminous liquid which does not coagulate even at a temperature of 100°. This experiment, performed with egg albumen, formed the starting-point of the present research. The mercury pneumatic machine extracts not only the gases from albumen, but the volatile salts. The two cases are considered separately. The authors show—(1) that carbonic acid is the agent of coagulation of albumen by heat; and (2) that albumen, deprived of its volatile salts, is transformed into globulin.

New Treatment of Cholera, and probably of Yellow Fever, by Phenic Acid and Phenate of Ammonia Subcutaneously Injected.—M. Declat.

Extent of Variations of the Solar Diameter.—M. Respighi.—In this preliminary note the author replies to P. Secchi's assertion of his instrument being faulty on account of the weak dispersion of the prisms, causing undulations and oscillations, more or less marked, at the edge of the spectral image of the sun: whereas in P. Secchi's instrument, with highly dispersive prisms, the edge is still and distinct.

Action of the Respiratory Apparatus after opening of the Thoracic Wall.—MM. Carlet and Strauss.—The

CORRESPONDENCE.

PUBLIC ANALYSTS.

To the Editor of the Chemical News.

SIR,—Your able article on "Public Analysts" in the CHEMICAL NEWS of last week expresses the feelings and opinion of many aggrieved chemists.

It is mortifying to perceive persons of no more knowledge of chemistry than is acquired in the usual course of hospital instruction step into those appointments intended by the legislature and the nation to be filled by men whose training and education have fitted them for the profession of analytical chemist. It is not possible that a medical man, who, previous to his election to the post of analyst by a body of small grocers and dairymen, has perhaps never performed a quantitative analysis in his life, can, after three months study even in a special laboratory, have obtained sufficient experience in analysis to fit him for the responsible position he is elected to.

One might explain the fact of the analyses now performed by these gentlemen not showing many cases of serious error on the hypothesis that, when a mistake through want of skill or manipulation is imminent, the statement of analysis is so arranged as to screen the analyst himself from any possible imputation.

But really, Sir, the number of analyses that have been

authors experimented on a man having a fistulous opening into his pleura. They find—(1) That the lung of the injured side follows, to a certain extent, the movements of the thoracic cage, expanding during inspiration, and contracting during expiration, thus behaving similarly to the sound lung. (2) During closure of the thoracic opening there is intensification of the preceding phenomena; hence, after the operation for empyema, the wound should be kept closed as hermetically as possible by means of an apparatus of caoutchouc. (3) The repeated efforts after the operation form a sort of pulmonary gymnastics, which the physician should utilise.

Researches Relative to the Action of Heat on Carbonaceous Virus.—M. Davaine.

Influence of Sulphates in Production of Goitre, apropos of an Epidemic of Goitre observed in the Barracks at St. Etienne.—M. Bergeret.—The author holds the theory just indicated; but in the case of these barracks, in which there are at present some 250 goitrous soldiers, the cause (sulphate of copper) is not traceable to the water, which is extremely pure, and gives no precipitate with salts of baryta or of silver or with ammonia; photographers use it in place of distilled water. The explanation given is as follows:—For an adult to be in perfect health the anatomical tissues and organs must receive assimilable principles in equal weight with those which they incessantly destroy to maintain animal heat, and produce the mechanical work required of them. If the receipt is not equal to the expenditure there is consumption anæmia. Something of this kind occurs in the goitrous soldiers of the barracks; they have excessive work, and have not a diet proportioned to the force expended. Again, it is known that when a muscle is exerted continuously, or when it is subjected to a continuous electric current it becomes acid (consuming its own substance) the acids produced being sulphuric and phosphoric, at the expense of the sulphur and phosphorus contained in the albumenoid matters. Under such conditions a man has in circulation in his blood an abnormal quantity of sulphates, exactly as if he drank water containing these substances. From an analysis of the urine of the goitrous soldiers at different stages of the disease, M. Bergeret finds that the maximum quantities of sulphates is during the full progress of it; it is three or four times that in the normal state. The urine at the commencement ranks next, and then that of the convalescent stage.

Remarks by Baron Larrey on the Communication Relating to Acute Thyroiditis, called Epidemic Goitre, among Young Soldiers.—The Baron has frequently found young soldiers suffer from an enlargement of the thyroid gland and neighbouring tissues owing to pressure of the shirt button, coat collar, and clasp of the capote; a purely mechanical cause. On replacing the collar with a cravat the glandular swelling disappeared. He is unwilling to accept the term *epidemic goitre* for an affection at once simple and easily remedied, and which he calls thyroiditis; and he suggests the possibility of the mechanical cause acting in the St. Etienne case.

October 6, 1873.

Notice of a New Derivative of Propyl. (Continuation.)—M. A. Cahours.—The author has prepared and examined oxalo-propylic ether, $C_6H_8O_8$. It boils between 209° and 211° . If alcoholic ammonia is allowed to act upon it a crystalline substance is obtained of the formula $C_4H_2NO_3C_6H_5O$. Carbonate of propyl, a colourless limpid liquid, boils between 156° and 160° . Its composition is $C_4H_8O_3$. Salicylate of propyl, $C_{10}H_{12}O_6$, boils between 238° and 240° . It is sparingly soluble in water, and has a hot aromatic taste. With chlorine and bromine it gives rise to crystalline products of substitution. Phenate of propyl, $C_{18}H_{20}O_2$, is a colourless mobile liquid of a pleasant odour, boiling between 190° and 191° . It is energetically attacked by bromine and nitric acid, and

yields with sulphuric acid a copulated acid. Nitrite of propyl, $C_6H_7NO_3$, boils between 43° and 46° . It is a homologue of nitrous ether, and isomeric with nitropropane.

Elastic Yellow Tissue, and on Proximate Organic Analysis.—M. Chevreul.—The author maintains that Bichat first recognised the yellow elastic coating of the arteries as a distinct tissue, and insists on the importance of seeking out the proximate principles contained in living beings.

Sanitation of Marsh Lands by Means of Eucalyptus Globules.—M. Gimbert.—The author maintains that this tree, a native of Australia, has the power when planted in marshy lands of improving their sanitary conditions, as has been proved in Algeria and Cuba. It drains the swamps, and at the same time gives off antiseptic vapours.

Condensation of Gases and Liquids by Wood Charcoal; Thermic Phenomena Arising on Contact of the Liquids, and the Charcoal Liquefaction of the Condensed Gases.—M. Melsens.—This paper has been already noticed.

Production of Certain Crystalline Borates in the Dry Way.—M. A. Ditté.—The author makes use of a mixture of equal equivalents of alkaline chlorides in which he introduces the amorphous borates or the elements of the salts which he wishes to obtain. The bottom of the crucible being heated to redness a part of the borate dissolves in the fused mass, and crystallises in the upper and cooler portions. In this manner the borates of lime Bo_2O_3CaO ; $3CaO, 2Bo_2O_3$; and $2CaO, 3Bo_2O_3$; and the borates of strontia, $SrO, 2Bo_2O_3$; $2SrO, 3Bo_2O_3$; SrO, Bo_2O_3 ; and $3SrO, 2Bo_2O_3$.

Researches on Tribromacetic Acid.—M. H. Gal.—This acid consists of—

Carbon	87.0
Hydrogen	0.33
Bromine	87.50
Oxygen	3.47

100.00

It is easily etherised. In presence of alkalis and under the action of heat it is decomposed, giving rise to bromoform and the carbonate of the base employed. This acid is very energetic, its salts crystallise readily; that of baryta forming long needles, and that of copper bulky prisms, apparently isomorphous with the acetate.

Claim to Priority as regards the Action of Ammoniacal Gas on the Nitrate of Ammonia.—Dr. E. Divers.—With reference to the memoir of M. F. M. Raoult on this subject (*Comptes Rendus*, May 12, 1873). Dr. E. Divers shows that his paper on the same reaction was presented to the Royal Society October 29, 1872, read January 9, 1873, and published in its *Proceedings*.

Note on Means for Maintaining in a Given Place a Temperature Nearly Constant, and for Moderating in Summer the Temperature of Dwelling Houses.—Gen. Morin.—The principle of the author's method is to renew the air regularly through the introduction by moderated aspiration of fresh air at constant temperature. It is known that at a depth of about 24 metres the internal temperature of the ground is constant. A supply of air is drawn from pits at this depth, or a less depth may suffice. The general dispositions are as follows:—The principal room, in which the temperature is to be kept constant, is preceded by another of nearly the same capacity (or only a small antechamber), which acts as a sort of dam for the entering air. This room should have walls, ceiling, and floor pretty thick. The floor and walls rest upon vaults; the walls are surrounded at a short distance by an isolating *enclente* of the same form, communicating with the vaults and the bottom of the aération pits. Orifices made near the top of the ceiling of the room and that of the *enclente* are in direct but distinct communication with draw tubes (*tuyaux d'appel*) in which are burners kept lighted under

constant pressure; their number varied according to the season. The air to be introduced into the principal room, into the subterranean vaults, and into the envelope, is taken from near the bottom of the pits by a special pipe of suitable size. The added building may be in a street, and may be lighted by double windows on the north side; the interval in the windows being in free communication with the isolating envelope. The author shows, from Newton's law, that the volume of air to be introduced is greater the nearer the temperature to be maintained inside approaches that of the air introduced, and the more extensive the cooling surface (it would become infinite if the interior temperature were equal to that of the introduced air). Further, that, other things equal, this volume will be proportional to the value it is judged convenient to assign to the fraction—

$$\frac{T - T'}{T' - t}$$

where T is the temperature external to the added building or its envelope, T' the internal temperature, and t the temperature of air to be introduced into it. The question is simplified whether the fraction is supposed = 1. (Some numerical examples are given.) In places where instruments of precision are kept the temperature should be a little above that of the air introduced; otherwise the entering air in cooling deposits on the walls and apparatus a portion of its vapour. The foregoing arrangement is valuable for various applications, as places of meeting, places for keeping food, &c.

Report on Memoir by M. Mannheim on the Trajectory Surface at the Points of a Figure of Invariable Form, the Displacement of which is Subject to Four Conditions.

Studies on Phylloxera.—M. Max Cornu.—The author asserts the identity of the insect attacking the roots with that attacking the leaves, but it seems less attracted to the leaves.

Effects of Sulphide of Carbon used to Destroy Phylloxera on the Vine Itself.—M. Lecoq de Boisbaudran.—The leaves of vines thus treated have withered, though remaining attached to the branches. The remedy seems effective against phylloxera but, besides injuring the vines, is too expensive to be used.

Size and Variations of the Sun's Diameter.—(Second note by M. Respighi.)—P. Secchi has stated that the duration of passage of the solar diameter, measured by mono-chromatic images obtained in the spectroscopic telescope with the direct-vision prism before the slit, was less than the duration given in the Greenwich Nautical Almanack by about 0.6 s., whence he infers that the diameter of the mono-chromatic image of the sun is about 8 seconds less than the diameter of the image with compound light, obtained by the simple telescope with coloured glass. M. Respighi is unwilling to admit this difference. He suggests possible causes of error; imperfect rectification and instability of instrument, influence of atmospheric refraction, but more especially the influence of variations of temperature of the prism. These sensibly displace the spectral lines. The results are constant P. Secchi says; but it is replied, that during each passage of the solar image the temperature of the prism could not continue constant, and its variations would be reproduced periodically in successive passages (independently of the absolute temperature). It is precisely these periodic variations which might displace the solar image by a quantity nearly constant in all the successive passages. (This influence is much less sensible in the author's own instrument, in which the aperture is reduced by a diaphragm, and the prism has little absorption.) Other possible causes of error are the undulation or agitation of the sun's border, and the personal error in observation of the two contacts. Some of the causes mentioned are avoided by using the objective prism. The author's observations by both methods gave results differing very

little from those in the Nautical Almanack (not more than + or - 0.12 sec.)

Theory of Earth Pressure.—M. Curie.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, Tome xxxii., No. 6, October 9, 1873.

Absorption of Gases by Charcoal, and their Spontaneous Liquefaction.—M. Melsens.—This chemist has obtained wood charcoal absolutely pure, and possessed of such high absorptive power that it can concentrate in its pores its own weight of gas. When charcoal thus saturated with any of the more readily liquefiable gases, such as cyanogen or chlorine, is placed in a glass tube fitted with a neck bent at right angles and closed at one end, and heated to 100° by a current of steam, the gas escapes, and compressing itself in the closed end of the tube passes at once to the liquid state.

New Generator of Electricity.—M. Clamond has constructed a new thermo-electric apparatus, which is ready to give a powerful and constant current whenever the furnace is lighted, and from which important industrial results are expected.

No. 7, October 16, 1873.

Cultivation by Means of Dynamite.—It is proposed, instead of ploughing or digging the ground, to bore holes, fill them with dynamite, and explode them!

No. 8, October 23, 1873.

This number contains no original chemical matter.

No. 9, October 30, 1873.

International Patent Law.—The Congress of Vienna has unanimously passed resolutions in favour of this desirable reform.

Phosphates of Quercy, of Lot, &c.—These phosphates appear to furnish phosphoric acid to the soil if spread on the land in their natural state, without any other treatment except grinding to powder. They appear to contain a proportion of bibasic phosphate, which accounts for their solubility and efficacy.

Method of Determining Sugar by Means of a Salt of Iron.—M. E. Riffard.—Perchloride of iron solution, prepared by dissolving in pure water the crystalline perchloride of iron, requires to 100 milligrams of iron 2.587 grms. of sugar to remain unprecipitated in presence of ammonia. 25.87 grms. of the sugar to be tested are dissolved, a few drops of oxalate of ammonia added to throw down any lime, filtered, and the solution made up to 250 c.c. Of this 25 c.c. are taken, and according to the number n of hundredths of pure sugar contained in the sample n hundredths of iron may be added, and will remain dissolved. In two determinations different results are obtained, viz., with n milligrams of iron, a limpid solution; with $n+1$, a precipitate; n being the percentage of sugar in the sample. With sugars of unknown origin the sample is previously shaken up in the cold with alcohol 95 per cent, and filtered to remove inverted sugar, which has a stronger action on iron than crystallisable sugar. The author states that the results obtained by this method agree with those furnished by the saccharimeter.

Treatment of Resin Oils.—When heat is applied to the retorts a light oil, crude pinoline, passes over at first, and then caenes. The receivers are changed, and the fire augmented, when the heavy oils pass over, and colophonium is left in the retorts. The heavy oils are of a deep violet colour. They are boiled for a day with water, and a part of the matter which passes off with the steam is collected. The next day the water is drawn off, and the residue saponified with caustic soda at 36° F. The almost solid product is then heated anew till no more oil distils over. The oil which has been distilled (single rectified) is submitted again to the same treatment, and that which finally passes into the receiver is called double

redified. It is used for adulterating fish oils. Crude pinoline contains acetic acid, from which acetate of lime may be prepared by neutralising the crude product of distillation with chalk, and re-distilling the oily liquid.

Use of Slags.—At Onabruck slags are granulated by being allowed to flow at high temperatures into water. Thus divided it can be used as ballast for railways. If much alumina is present the slags can be used in the manufacture of alnm.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, par Ch. Mène, No. 35, 1873.

Manufacture of Iodide of Potassium from the Mother-Liquors of Kelp or Crude Soda.—This process consists in transforming into iodates the alkaline iodides contained in kelp lyes; then in precipitating the iodic acid with a soluble salt of baryta, heating the precipitate with a solution of sulphate of potassa, which yields a solution of iodide of potassium, evaporating this to dryness, and finally fusing the residue, and allowing the solution of the iodide of potassium thus obtained to crystallise. The conversion of the iodides of the mother liquors into iodates may be effected by one of the methods indicated below; but it is important to precipitate entirely or in great part the sulphuric acid contained in these waters by means of chloride of barium. At the same time a little silicic acid and other impurities are eliminated, and it becomes more easy to treat the product obtained by the iodate of baryta. After having collected this precipitate the mother liquor is evaporated to dryness to destroy the organic matters present, and the residue is fused. The liquid obtained from the solution of the melted mass after being freed from insoluble matters is rendered alkaline by the addition of a caustic or carbonated alkali to such an extent that there may be 5 atoms of caustic alkali or 10 of carbonate for each atom of iodide. This addition of alkali is unnecessary if the fourth of the following methods is to be employed. (1) A current of chlorine is passed through the liquid until the iodide is transformed into iodate, but no longer. (2) A solution of an alkaline permanganate is added to the liquid until a very slight but permanent rose-coloured tint is produced. The precipitate of manganese is filtered off, and re-converted into permanganate by fusion with soda or soda and saltpetre. (3) An electric current is passed through the liquid. (4) An atom of an alkaline chromate is added for every atom of iodide present. The whole is evaporated to dryness, cautiously heated without raising the temperature to redness until the iodide is converted into iodate. After the iodic acid is removed from the mother-liquor the bromide which may remain in solution is transformed into bromate by the first or fourth method above-mentioned.

No. 36, 1873.

This number contains a notice of a machine for roasting coffee, starch, barley, &c.; the effervescing beverages manufactured by Nitot et Cie.; and of the method of rendering cloth water- and fire-proof carried out by Dujardin.

No. 37, 1873.

This number is totally free from chemical matter, whether scientific or industrial.

Revue Scientifique de la France et de l'Etranger, October 11, 1873.

M. Zinin shows that desoxybenzoin dissolved in alcohol with caustic potassa absorbs oxygen from the air, forming benzoic acid and a very complex body, benzamaron; which, on prolonged ebullition with caustic potassa, reforms desoxybenzoin and amarinic acid.

Fritsche finds that tin may be rendered crystalline and brittle by exposure to intense cold.

Boutlerow has made experiments on isobutylene to verify the hypothesis of a double series of atoms of carbon in the non-saturated carbides of hydrogen. Isobutylene yielded instead of crotonylene an isocrotylic ether.

Mendeleeff has determined the calorific capacity of cerium.

Boradine has studied a monatomic alcohol containing 10 atoms of carbon obtained by the action of sodium on valeraldehyde.

Lazarenko having found that benzoyl-anilid does not yield directly nitro-derivatives has prepared them by causing nitro-benzoic aldehyde to act upon anilin, and benzoic aldehyde and nitro-benzoic anilin upon nitrilanin.

Struve concludes that all combustion generates ozone, peroxide of hydrogen, and nitrate of ammonia.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATION.

Improvements in the treatment of stable manure and for obtaining useful products therefrom. Arthur McDougall, of the firm of McDougall, Bros., manufacturing chemists, Manchester and London. February 13, 1873. No. 542. This invention consists in treating stable manure or litter, which has hitherto been used only as a fertilising agent, in such a manner as to render it available for use in the manufacture of paper-pulp, and consists in thoroughly washing such manure or litter with water by any suitable or well-known mechanical contrivance, with a view to the removal of the fecal matter therefrom. The cleaned straw thus obtained may either be treated by any suitable or well-known process for the manufacture of the same into pulp for the making of paper and similar products, or it may be dried and again used as bedding for horses and cattle generally.

Improvements in electric lightings. Henry Highton, M.A., Putney, Surrey. February 13, 1873. No. 545. This provisional Specification describes special arrangements by which the gold-leaf instrument is applied advantageously to work long lines, especially where the insulation is defective.

Improvements in the manufacture of iron and steel. Jacob Geoghegan Williams, of Saint Stephen's Crescent, Bayswater, Middlesex. February 14, 1873. No. 547. Ore in a divided state is employed together with materials to prevent its falling through the interstices of the fuel. Apparatus is also described for charging the furnace. The "Uchatus" process is also described, and granulated metal is produced for the manufacture of steel and malleable castings.

An improved composition for removing and preventing incrustation in boilers. David Hutchinson, Mile End, and William George Bridges, Stepney, Middlesex. February 14, 1873. No. 551. The features of novelty of this invention consist in combining together catechu, chlorine, linseed, sodium, nitre, sulphate of potash, alum, calcium, and ammonia, in certain proportions.

Improvements in apparatus and in the materials and appliances employed for the filtration of water, sewage, and other fluids, whereby manure and other valuable products are separated, precipitated, and obtained therefrom. Francis Henry Atkins, engineer, 63, Fleet Street, London. February 14, 1873. No. 556. One part of this invention has for its object improved arrangements of apparatus and mechanism for the filtration of water, sewage, and other fluids, being specially adapted for the separation of the grosser impurities from water for manufacturing and other purposes, or for filtering the effluent water of sewage, the polluted water from paper or other manufacturing works to prevent the pollution of rivers, or for other purposes. The invention also relates to the preparation and application of coke in solidified blocks or slabs, for the filtration of water, sewage, or other fluids. The filtering materials in the form of blocks are secured in open removable frames or slabs. The frames with the filtering blocks or slabs are then placed and fixed in position across a water-course, tank, passage, or channel, through which the water, sewage, or other fluid to be filtered is arranged to flow. Part of the series of frames may contain sponge, felt, or other filtering materials. When the filtering slabs are coated with the impurities, they are removed and allowed to dry, and are cleaned by scraping, the scrapings being converted into manure. According to another of these improvements, the grosser impurities are withdrawn from water, sewage, or other fluids by means of endless bands of wire-gauze, hair-cloth, canvas, sponge, or other suitable materials mounted upon rollers, and arranged so as to revolve in a tank or passage, through which the fluid to be filtered flows. Another part of these improvements has for its object the application of galvanic, magnetic, or electrical action to filtering apparatus, reservoirs, or tanks, for the purpose of precipitating organic and inorganic matters or impurities held in suspension or solution in the water or other liquids.

Improvements in the deodorisation of excreta, and in the manufacture of manures therefrom. Major-General Henry Young Darracont Scott, C.B., Ealing, Middlesex. February 15, 1873. No. 570. The object of this invention is the prevention of nuisance in dealing with night-soil and various liquids, and the fixation of their fertilising elements so as to render them of valuable marketable commodities.

Improved methods for purifying gutta-percha. Thomas Cattell, M.D., Clarendon House, 25, Clarendon Square, Middlesex. Fe-

bruary 17, 1873.—No. 587. By this invention crude gutta-percha is deprived of its impurities by treating it by—Process No. 1. The solutions of gutta-percha, made according to Specification No. 446, 1859, are filtered or strained, and the gutta-percha recovered by means of alcohols, vapour of alcohols, or steam. Process No. 2. Crude gutta-percha is softened by the action of solvents, hot water, or steam, and mechanically strained, and the solvents afterwards removed and recovered by means of steam. Process No. 3. Crude gutta-percha is softened by a mixture of the usual solvents of gutta-percha with alcohols, and mechanically strained, and any solvent adhering to the gutta-percha drawn off, and collected. Process No. 4. Gutta-percha, obtained by what is termed in the said Specification, No. 446, "the process of congelation," is broken up and passed into a chamber, where it meets either the vapour of alcohols or steam, and the solvents of the gutta-percha, or the alcohols used are collected. *Improvements in the process of treating and preparing gutta-percha, rendering the same better suited for packing purposes.* Annetta Jane Honor Hutchings, 2 and 3, Quay Head, Bristol. February 17, 1873.—No. 588. The inventor takes malt or distilled vinegar, chilis, cloves, ginger, pimento, mace, nutmeg, all or some, and (1st) grinds and commingles together the spices, and (2nd) places the ground spice in an earthen or other vessel with perforations in the bottom, which vessel is placed in another earthen or other vessel. Both vessels are placed in a boiler, the vinegar being poured into the inner vessel up to the spices, and the contents of the boiler being kept simmering for a sufficient time, the strength of the spices is drawn out into the second vessel, and, upon being filtered, is fit for bottling.

NOTES AND QUERIES.

Dilatation and Purification of Glycerin.—Can any of your readers give, or refer the enquirer to, information on the above?

Maximum and Minimum Thermometers.—Mr. H. Smith, in his "Chemistry of Sulphuric Acid Manufacture," describing his experiments on temperature, says that he used "ordinary maximum and minimum thermometers" fixed on glass; I should feel much obliged if he would give me a further description of the sort he used, and if he could say where such are to be procured.—A MANUFACTURER.

Malleable Cast-Iron.—I should be thankful if you, or any of your scientific correspondents, would, through the medium of your paper, kindly give me a little information respecting malleable iron castings. (1). Are the so-called castings malleable? (2). Is malleable cast-iron chemically different to common cast-iron, and what is the difference? (3). How is malleability produced in cast-iron? By oxidation of the carbon, or some other chemical process? By a mixture of wrought-iron, or by annealing?—RICHMOND BAKER, Cert. Teacher of Science, The Gouger Street Academy, Adelaide S.A., Sept. 10, 1873.

Iron Wire in Claret.—A small fragment of wire having been accidentally left in a bottle of claret, communicating a most abominable taste to it, I dropped in a scrap of silver-foil and corked it up again, removing the remnant of iron wire. In a few days I tasted the wine again, and found that, though nasty, the worst part of the taste, that of hydrogen sulphide, had disappeared. Had the sulphur been present as impurity in the iron? It has struck me that perhaps small aquarium tanks might be saved if, at suspected spots where minute fixed organisms are perishing, scraps of silver-foil were placed with the tongs; at all events they would remove the H_2S evolved. May I ask if this has been tried, or if, in the opinion of chemists and naturalists, it is likely to be of use?—MARSHALL HALL.

A New Method for the Preparation of Chromic Acid.—The following method is based upon the decomposition of barium chromate by nitric acid, with the separation of the barium nitrate thus formed by means of sulphuric acid. The chromate is dissolved in water and added to boiling nitric acid (diluted with an equal bulk of water) till completely saturated; the whole is then allowed to cool, when the greater quantity of the barium nitrate crystallises out. To the mother-liquor a sufficient quantity of free nitric acid is added, to precipitate the remainder of the barium; the barium sulphate settles readily to the bottom of the vessel. The supernatant liquor, containing chromic and nitric acids, is drawn off and evaporated to dryness on a water-bath, when all the nitric acid is expelled, leaving a residue of nearly pure chromic acid, which may be purified by crystallisation. By this method nearly the theoretical quantity can be obtained from potassium chromate.—J. McLELLAN, Shawfield Chemical Works, Glasgow.

Detection of Petroleum Spirit in Coal-Naphtha.—(Reply to E. J. D.).—First, test the specific gravity of the naphtha; should this indicate, say, oil, or ether, and the naphtha is, for some grounds for suspicion as to presence of petroleum spirit. Next, place about 250 c.c. of the suspected naphtha in a flask fitted with Liebig's condenser and thermometer, and distil off all coming over below 115° to 120° C. Take this portion boiling below 120° C., and place in a fresh flask, and distil again, collecting up all coming over below 85° to 95° C. This is tested as to its odour and specific gravity, and, if petroleum spirit has been used, the former is usually sufficiently unmistakable, but is further confirmed by an examination as to the latter, the extreme lowness of which will be the point. Scotch naphtha is very usually a somewhat lower specific gravity than English; in fact, they are frequently met with as low as 0.86. To decide if genuine, i.e., free from spirit, make the above-mentioned examination in the manner described, and, if the lowest boiling portion extracted thus from the bulk possesses, after the second distillation and extraction, a specific gravity not differing very materially from that of the bulk of the original naphtha, the sample may be considered genuine as regards light petroleum spirit.—WATSON SMITH, F.C.S.

Notes on the Utilization of Sewage.—From the "Report of the Main Drainage Committee for 1864," vol. (487). (1866. (Mr. Bowling). Mr. Hugbica, in his book on waterworks, says, p. 291, that the cost of covered reservoirs varies from 30s. to £3 per thousand gallons of capacity, and that the cheapest reservoir which was built at all, at Silverstream, in Great Britain, cost £1000 per 1000 gallons, and the cost, exclusive of land, is said to have been £200. He says that a reservoir to contain 2,000,000 gallons would cost £161, so that it appears that a reservoir costs about £2 for every 1000 gallons. 1990. (To Mr. Ellis). With regard to quantity, is there not among agriculturists a system of high farming and the contrary?—Yes. 1991. And does not that consist, as in Mr. Mechi's case, of putting on very pure land a very large quantity of very rich manure?—You can put a large quantity of solid manure, not of liquid manure, because the liquid manure will run away.

1992. Then your remark applies that there is a limit to liquid manure, but not to solid, is that so?—If you put a large quantity of liquid manure on the earth than the earth can deal with, it runs to loss. Professor Way's evidence proves that.

1993. Mr. Mechi. But I tell you that I apply sewage to land in frosty weather, and that I have seen it a foot in thickness in ice, and that when the thaw came it melted gradually on to the land and became absorbed, would it alter your opinion?—That would be the case, no doubt, but during the continuance of the frost.

1994. There would be nothing to prevent the farmers from applying it at all times, but I assume that they would not do so.

2003. Of course there would be no annoyance from the sewage being in a frozen state?—Of course not.

2004. (To Mr. Ellis). Have you made any calculation of the height?—Yes, if we had to lift the sewage on the north side to 460 feet, that would cost us £367,121, or 4d. 0.07, 121 for each ton, or a little over 7s. for each ton.

2005. Does that include the cost of the sewage as well as the cost of the carriage?—That would be the cost of pumping only, and lifting it to a height of 460 feet; and that, I believe, is excessive.

2051. (To the same). The evidence of Professor Way proves that there is a limit to the power of the earth to receive manure, and that limit is very soon reached; therefore, when you put sewage at the great quantity that Mr. Lawes does upon the earth, you must run it away to loss because the earth cannot deal with it.

2052. What amount of sewage per acre per annum did he supply?—On one part of the land 3000 tons, on another part 6000 tons, and on another part 9000 tons per acre.

2053. Do you know what amount Mr. Mechi applies to land with advantage?—I think it is very small; it is 45 tons, or something of that kind.

2054. (To Mr. Ellis). Would you be astonished to hear that a large proprietor has erected works, at very great cost, to be used in a certain district, and that all be required was that the occupiers of the ground should pay for the pumping?—I should be astonished if no explanation were offered.

These works were erected by the Duke of Northumberland, and then the inhabitants and occupiers of the land in the district refused to pay for the pumping.

2151. (To Mr. West). Have you a detailed estimate there in your hand?—Yes; so far as I can pump up at 100 ft. lift, or you may divide the 300 feet or 400 feet into two lifts. Cornish pumping-engines, including boilers, erected complete, but exclusive of pumps and buildings, will cost £35 per actual horse-power. I cannot estimate the cost of buildings, not knowing the cost of foundations, &c. When in duplicate they will cost £30 per actual horse-power. For all heights less than 30 feet, the single-acting drawing-pump would be used, and above this height the plunger forcing-pump. The valves should be on the principle of Harvey and West's double beat valves. The cost of lifting 1000 tons 50 feet high will be 2s. 4d. for the water; 50 feet 2s. 4d. must be added; therefore to lift this quantity 100 feet will cost 4s. 8d. 200 feet, 9s. 4d.; 300 feet, 14s.; and 400 feet, 23s. 4d. The above includes coal, labour, oil, tallow, and bemp. The cost of lifting one ton is very little; 41 tons can be lifted 500 feet high for one penny. I would recommend a brick-lined shaft, 10 feet in diameter, to be placed at the bottom of the well, through which all the fluid should pass before arriving at the entrance of the suction-pipe; the sieve to be so mechanically arranged for hauling to the surface for cleaning.

Now Ready, Price 5s.

Milk-Analysis.—A Practical Treatise on the

Examination of Milk (Including Cream, Butter, and Cheese). By J. ALFRED WANKLYN, M.R.C.S., Corresponding Member of the Royal Bavarian Academy of Sciences, Public Analyst for Bucks.

London: TRUBNER AND CO., Ludgate Hill.

Analysis of Food, Water, and Air.—Mr.

WANKLYN has opened a Laboratory at 117, Charlotte Street, Fitzroy Square, and is prepared to give Practical Instruction in Chemical Analysis to Medical Officers of Health, and to persons proposing to undertake the duties of Public Analysts under the new Act.

Two Courses of Lectures on Geological

MINERALOGY will be given at KING'S COLLEGE, LONDON, by Professor W. H. STURTEVANT, where the public are admitted on paying the College fees. One Course is given on Wednesday and Friday mornings, from 9 to 10 o'clock, commencing Wednesday, October 8th, and terminating at Easter, 1874. The other Course is given on Thursday evenings, from 8 to 9, commencing October 9th. The lectures are illustrated by a very extensive collection of specimens.

Practical Instruction in Mineralogy and Geology is given by Prof. TENNANT, F.G.S., at his residence, 149, Strand, W.C.

THE CHEMICAL NEWS.

VOL. XXVIII. No. 729.

MEMORANDUM ON THE PURIFICATION OF DRINKING-WATER,

WITH SPECIAL REFERENCE TO THAT WHICH IS LIKELY TO BE MET WITH ON THE GOLD COAST.

By WILLIAM CROOKES, F.R.S., &c.

THE following memorandum has been drawn up at the request of Sir William Muir, of the Army Medical Department :—

In the absence of any specific information as to the quality of water likely to be found on the Gold Coast, the following remarks are necessarily somewhat general in character.

Disinfection of water cannot be effected by one substance which removes all the evils at once. There are likely to be many septic bodies in various conditions, and each has to be attacked in a special way.

The danger certainly lies in the organic matter present in the water; but it bears no constant relation to the quantity present. Water may contain a large quantity of peaty organic matter—as much as 4 or 5 grains to the gallon—and be harmless: whilst a very small fraction of this quantity of another kind of organic matter may make it a deadly poison.

Malaria appears to be caused by the decomposition of organised bodies. Soils generally are acid, and the drainage-waters from them are comparatively harmless. But, under conditions which are frequently likely to obtain in a tropical country,—such as great heat, low lying position, damp marshy soil, exuberant and dense vegetation preventing excess of solar rays to the soil—the soil is likely to become more alkaline than the vegetation will bear; putrefactive decomposition will commence, the oxygen in solution in water will be insufficient to restore the balance, and malaria will be the result. In the drainage water from such a tract of country the germs of fatal diseases are almost certain to be present,—to what extent we are ignorant.

That the poison is in the water rather than in the air is well illustrated by a circumstance related by Dr. Woods (CHEMICAL NEWS, vi., 307). Two ships were dispatched simultaneously with troops from Algeria to France, both under similar circumstances, excepting that the supply of water had been drawn in one case from the low marshy lands where ague was prevalent, whilst the other ship had taken water from a locality situate at a greater elevation, and where the disease was unknown. The passengers on board the first transport were quickly seized with remittent fever, whereas no case of illness occurred on board the second vessel.

The means relied upon for destroying or neutralising the poison in bad water are, with the general public, addition of permanganate of potash, and filtration through charcoal.

For general purposes these may be sufficient, but in cases of real difficulty they are likely to be most unsafe, if not positively harmful as leading to a fancied security.

Permanganate of potash exerts extraordinary destructive powers on some kinds of organic matter. Thus the offensive gases of putrefaction are at once deodorised, and many kinds of organic matters, such as oxalic acid, sugar, &c., are almost instantly destroyed. With other substances, however, such as the scent of musk, urea (from urine), the strong smelling valerianic acid, lactic acid (from sour milk), and butyric acid (from rancid butter),

permanganate of potash has little action, and it has not much effect on strychnine, and some other violent poisons.

If we divide the organic matter in water into three classes, viz. :—

- (1). Matter already in a state of putrefaction,
- (2). Matter ready to become putrid,
- (3). Matter which is slow to decompose,

it will be found, *practically*, that the matter in class 1 will be the only organic matter which permanganate of potash will remove. It will destroy this at once, whereas to destroy organic matter of the second class with permanganate of potash will require from fifteen minutes to an hour; and to destroy matter of the third class will require from some hours to some days. Moreover, living matter has considerable resistance to the oxidising power of permanganate of potash; microscopic animalcules will live for upwards of an hour in water tinted with it, and living beings, visible to the naked eye, will live in a much stronger solution.

If a soldier, provided with permanganate of potash, after mixing a little with water waits only a few minutes before drinking it, he will certainly imbibe most of the organic matter of classes 2 and 3; whilst he would have to defer quenching his thirst for about half an hour before the matter of the second class would be destroyed, and for at least a day before matter of the third class would be attacked; and even then he would be by no means safe.

Practically, however, if the soldier used the permanganate at all, he would not be likely to do more than wait for a few minutes.

But the probability is so great as almost to amount to a certainty that the septic matter of the water would reside in the organic matter of classes 2 and 3.

The specific disease-producing particles are doubtless organised germinal matter, or cells, possessing physiological individuality, capable of preserving their activity for a certain time when out of the water in the form of slime, or even dust, able to adhere to material objects, and to be carried from one place to another on the clothing or in currents of air.

To remove these bodies from water, permanganate would be inoperative within the time in which it would be allowed to act. Filtration through charcoal would at first sight appear to be a satisfactory safeguard; but it is not sufficient, for many reasons.

In the first place charcoal acts mechanically as a filter, and should therefore remove solid germs. But these cells are supposed to be so extremely small that it is doubtful whether they would be kept back by merely passing water rapidly through an ordinary filter, whilst if they were kept back they would accumulate only with their tremendous power for evil uninjured, on the upper side of the filter, ready at the first accident to act as the focus of a pestilence.

In the second place a charcoal filter acts as an oxidising purifier for the water which passes through it. The oxygen condensed in its pores destroys organic matter somewhat as permanganate of potash does. To keep charcoal efficacious, however, as an oxidiser, it should be frequently cleaned to get dry nearly every day, and should be frequently cleaned. Even at its best it is not likely that it will oxidise organic matter more readily than will permanganate of potash, and hence matters of the second and third class—probably the most dangerous of all—are likely to pass through.

There is another purifying agent which has stood the test of long experience, and which possesses properties which are especially valuable in the present case. I allude to sulphate of alumina. When this salt is added to water containing organic matter of different classes, it passes by that which is so easily oxidised by permanganate of potash, but it attaches itself to organised animal matter—living germs—and converts them into an insoluble substance like leather. It is not quite certain whether this tanning operation destroys

vitality: probably it does; but at all events the precipitate is capable of being filtered with the greatest ease, whilst the addition of sulphate of alumina in no way interferes with the use of the permanganate of potash. If fine clay be used along with the sulphate of alumina the precipitation takes place with great rapidity, and filtration need not be resorted to, but the clear water can be poured off the sediment in the course of a quarter of an hour.

Under the name of A B C compound a mixture of sulphate of alumina, clay, and charcoal has been successfully used by the Native Guano Company for the purification of sewage. At their works I have repeatedly seen the sewage of such places as London, Paris, Hastings, and Leeds, converted in the course of a quarter of an hour from an offensive looking, vile smelling liquid, into water, bright, clear, inodorous, and tasteless, non-putrescible, and so free from injurious matter as to allow delicate fish to live and thrive in it.

With a little necessary modification I consider that a mixture capable of acting thus on town sewage is the most suitable for the purification of water for drinking purposes on the Gold Coast.

I would suggest that the charcoal be omitted, and its place supplied by a permanganate. The ordinary potash salt will do, but if procurable in time I have reasons for believing that permanganate of lime would answer the purpose better.

I have prepared a mixture of—

1 part of permanganate of lime,
10 parts sulphate of alumina,
30 parts fine clay,

and find that when I add this to London sewage in the proportion of 20 to 10,000, the purification is very satisfactory, and the settlement rapid. With foul ditch water a less quantity will do.

The mixture can be filtered, instantly yielding a bright filtrate, or it can be allowed to settle for a quarter of an hour, when the supernatant water can be poured off equally bright.

I am not prepared to say what the price of this mixture would be, but it would probably not be many pence per hundred gallons of water.

PRELIMINARY INVESTIGATION OF THE FLUORESCENT AND ABSORPTIVE SPECTRA OF THE URANIUM SALTS.*

By HENRY MORTON, Ph.D.,
and H. CARRINGTON BOLTON, Ph.D.

(Continued from p. 234).

Uranic Oxyfluorides.

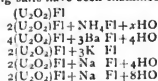
THE chemical relations of these salts have been made the subject of a special investigation by one of us, and will be found fully discussed,† but the following brief notes may be useful in this place:—

Uranic oxyfluoride is obtained by dissolving the sesquioxide of uranium in hydrofluoric acid. If the three-fourths oxide be treated with this acid, uranous fluoride also forms as an insoluble green powder, which may be separated by filtration.

Potassio-uranic oxyfluoride, $2(\text{U}_2\text{O}_2\text{F}) + 3\text{KH}$, is best prepared by adding potassio-fluoride to a solution of uranic nitrate, dissolving the lemon-yellow crystalline precipitate in warm water, and crystallising. The corresponding sodium salt, being very soluble, can be prepared in this manner; it is obtained with difficulty by evaporating a mixture of uranic nitrate and sodic fluoride in a desiccator. It has the constitution $2(\text{U}_2\text{O}_2\text{F}) + \text{NaF} + 8\text{H}_2\text{O}$. The

barium compound forms a crystalline precipitate; the ammonium salt is obtained only as a deliquescent mass.

The following salts have been examined:—



These all fluoresce with various degrees of brightness, and yield very remarkable spectra, having, in the case of two of the double salts especially, a strong similarity to the double oxychlorides in complexity of structure. Their absorption spectra are also marked.

Uranic Oxyfluoride, $(\text{U}_2\text{O}_2)\text{F}$.—This salt gives a spectrum which, in the general character of its bands, much resembles the acetate, normal sulphate, &c., or what may be called the normal type. There are, however, in it slight indications of inflections of brightness in the individual bands, which we find strongly developed in the double salts. These indications are, however, too delicate to be correctly represented in the cut, being, in fact, only recognisable when specially looked for. This spectrum is shown at 2 of Fig. 12. The absorption spectrum of this substance is likewise well marked, and is shown in 2 of Fig. 13. When dissolved in water, and acidulated with hydrofluoric acid, this yields an absorption spectrum such as is shown at 3 of Fig. 13. In this the general absorption is strong, and the bands are relatively faint. If no acid is added to the solution of the uranic oxyfluoride, we obtain a spectrum of absorption similar to the above, but with the bands all displaced a little upwards; thus—

Absorption-Bands of Uranic Oxyfluoride in Solution.

Bands.	1.	2.	3.	4.	5.	6.
With acid ..	93°0	103°0	114°0	124°0	136°8	—
Without acid..	95°2	105°0	115°4	125°0	137°6	150°0

The Double Oxyfluorides.

Of these the most brilliantly fluorescent is the potassium salt, and we will therefore describe it in detail, and the others by reference to it. This salt fluoresces pretty strongly, and yields a spectrum in which each band is composite, the stronger or brighter ones showing three elementary stripes, which are recognisable, but by no means so decidedly marked as those of the double oxychlorides. In Fig. 12, No. 1 will give some idea of this spectrum.

The other double fluorides of this class yield similar spectra, the positions of whose brightest parts are given below. The barium salt shows the same structure in its bands as the potassium one, but the others exhibit only single blended bands. The following table will give the positions of the brightest line in each group in the various spectra, these being named in their order of brightness:—

Fluorescent Spectra of the Double Oxyfluorides.

Bands.	1.	2.	3.	4.	5.	6.	7.	8.
Potassio..	32°4	39°2	46°8	54°7	63°7	73°9	83°4	89°8
Bario ..	32°0	38°4	46°4	54°2	62°8	72°0	81°4	89°2
Ammonio	32°0	38°4	46°4	54°2	63°3	72°9	82°7	91°3
Sodio ..	30°4	38°8	47°6	57°2	66°1	76°0	86°4	—

The absorption spectrum of the potassio oxyfluoride is shown at 1 of Fig. 13.

Uranous Fluorides.

The salts of this class examined, were those first studied by one of us, and described fully in *Zeitschr. f. Chem.*, [2], ii., 353, and *Bul. Soc. Chim.*, 1866, ii., 450.

Uranous fluoride, UF_2
Potassio-uranous fluoride, $2(\text{UF}) + \text{KF}$
Sodio-uranous fluoride, $2(\text{UF}) + \text{Na}$

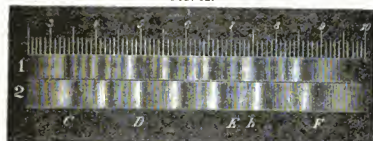
None of these show any fluorescence, but their absorption spectra are well worthy of note. That of the uranous

* Communicated by President Morton.

† *Zeitschr. f. Chem.*, [2], i., 323; *Bul. Soc. Chim.*, 1866, ii., 450.

fluoride is shown in 2 of Fig. 14, and that of the potassium salt at 1 of the same figure. One of these (2), as will be observed, consists of broad undivided bands, and the other (1) of bands strongly marked with subdivisions. Both are easily seen by pressing the powder-like substances between slips of glass, either alone or with a little water.*

FIG. 12.

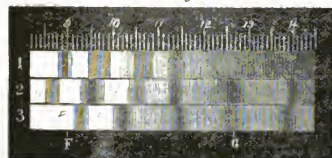


Oxyfluorides.

Uranic Formate.

This substance gives no fluorescence, and shows an absorption spectrum with faint bands located as follows:—88.5, 98.6, 106.6, 118.1, 129.2, 138.0.

FIG. 13.



Oxyfluorides.

Uranic Nitrate, $U_2O_3NO_3 + 6HO$.

The uranic nitrate fluoresces very brilliantly, and yields a spectrum of the same general character as the uranic acetate, sulphate, phosphate, &c.; in fact, the normal uranic spectrum. It also shows an absorption spectrum of well-marked and regularly disposed bands.

Both these spectra are well indicated in 1 of Fig. 1, with the exception that the absorption-band close upon F does not appear remarkably strong as the engraving might indicate, but, on the contrary, very weak. In the

Hagenbach*, and the former by Becquerel.† We have drawn attention already to the displacement suffered by the absorption-bands of this salt by change of solvent. Its neutral solution in water has a very faint fluorescence

Oxalates.

The salts of this class examined are the uranic oxalate, and the ammonio-, potassio-, and sodio-uranic oxalate.

The *Uranic Oxalate*, $2U_2O_3.C_2O_4 + 6HO$.—This is one of the salts observed by Stokes (See *Phil. Trans.*, 1852, part ii., p. 521). Its fluorescent spectrum is brilliant and well-marked, and consists of rather narrow bright bands showing what we have already described as the normal characteristics of uranic salts. The centres of its bands are located as follows:—

Fluorescent Spectrum of the Uranic Oxalate.

Bands.	1.	2.	3.	4.	5.	6.	7.
	40.0	48.8	47.5	67.0	77.0	89.3	

This salt has also a very well-marked absorption spectrum, in which the bands are regular in spacing and intensity. Their centres are located as follows, and are affected by solution and heat, as has been already stated, and is here shown.

Absorption Spectrum of Uranic Oxalate.

Bands.	1.	2.	3.	4.	5.	6.
Solid	98.0	108.0	118.8	130.0	139.6	152.0
Cold solution ..	97.5	107.8	118.4	127.4	137.2	150.6
Hot solution ..	97.0	107.4	117.3	125.5	136.0	148.2

The first three bands of this spectrum are very strong and black, and form a characteristic feature of the substance. They are the three noticed by Stokes.

Ammonio-Uranic Oxalate, $NH_4O.U_2O_3.C_2O_4 + 4HO$.—This salt is readily prepared by dissolving uranic oxalate in a solution of ammonia oxalate, and crystallises readily in strongly marked trimetric prisms. Its fluorescence is strong, and its bands are located as follows:—These bands resemble in appearance those of the double acetates, and the measurements are made at the brightest parts of each band.

Fluorescent-Bands of the Ammonio-Uranic Oxalate.

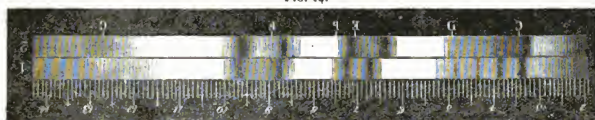
Bands.	1.	2.	3.	4.	5.	6.
	38.8	46.8	55.5	64.8	75.2	87.6

This salt shows also a well-marked absorption spectrum in which the bands (like those of the fluorescent spectrum just given) differ from the corresponding ones of the uranic oxalate by being much lower in the spectrum.

Absorption-Bands of the Ammonio-Uranic Oxalate.

Bands.	1.	2.	3.	4.	5.	6.
	96.4	106.6	117.6	124.0	136.0	148.0

FIG. 14.



Uranous Fluorides.

original drawing it was so marked to keep out of the fluorescent-band, with which it is almost or quite coincident. The spectra are thoroughly discussed by

* Some portion of this work has been carried out after Dr. Bolton's departure for Europe, and in the present case, being unable to consult with him, I think it best to state, on my own responsibility only, a point which comes up in this place. The sodio-uranous fluoride prepared by Dr. Bolton shows the same spectrum as the uranic fluoride. In his original paper, Dr. Bolton makes it as doubtful, and, in noting its reactions, mentions some which agree exactly with those of uranic fluoride. I am therefore inclined to think that the material he regarded as the sodio-uranous fluoride is a mixture.—H. M.

Potassio- and Sodio-Oxalates, $KOU_2O_3.C_2O_4 + 3HO$ and $NaOU_2O_3.C_2O_4 + 3HO$.—These salts are readily formed by dissolving uranic oxalate in solutions of potassio or sodio oxalate respectively. The potassio salt crystallises readily in large masses, forming monoclinic prisms, and the sodio salt in small crystals. The fluorescence of these was in both cases so weak that only three bright bands could be distinguished at all, and these seemed to correspond with the bands of the ammonia salt. The absorp-

* *Pogg. Ann.*, 1852, vol. cxlvii., p. 105.

† *Ann. de Chem. et de Phys.*, 1872, vol. xxvii., p. 569.

tion spectrum of the potassic salt was well defined as follows:—

Absorption-Bands of Potassio-Uranic Oxalate.

Bands.	1.	2.	3.	4.	5.	6.
	97.5	106.6	115.8	125.5	135.4	149.0

The sodio-uranic oxalate shows so feeble an absorption spectrum that three bands only can be recognised at 94.9, 104.6, and 116.5 respectively.

In solution, all these oxalates yield absorption spectra, which are very well marked and seem to be identical, carrying out the idea before suggested as to the breaking up of double salts when dissolved.

(To be continued.)

ON THE
ACTION OF BROMINE ON THE WATER-SALTS
OF SUCCINIC, MALIC, MALEIC, AND
PYRO-CITRIC ACIDS,

CRITICALLY EXAMINED AND INTERPRETED FROM THE
STANDPOINT OF THE "TYPO-NUCLEUS" THEORY.

By OTTO RICHTER, Ph.D.

In my two papers on the chemical constitution of succinic, malic, tartaric, and citric acids, I have endeavoured to embrace, by one theory, that particular section of mono- and poly-basic water-salts which are descended from the fine-begotten polyatomic alcohols, and it is with the view of still more fully developing and substantiating that theory, that I have bethought myself of extending my speculative labours in a new direction, and with a different choice of materials. A rich and plentiful supply of suitable materials has been found to spring from the action of bromine on the water-salts of succinic, malic, maleic, and pyro-citric acids, as also on their pure or chlorinated anhydrides. This searching and powerful reagent is understood to vary greatly in its effects, according as it is administered in the dry state or in the presence of water; but, considering the vast magnitude of my subject, an exhaustive article on which would far exceed the limits of this paper, I have deemed it advisable to confine my remarks to the action of bromine on the aforesaid water-salts only, and while it is applied in a watery solution.

I may now state, by way of introduction, that my interpretation of this order of chemical phenomena is founded on the hypothesis that there exist three different modes or methods, according to which bromine in solution is capable of manifesting its chemical affinities. By the first of these methods, 2 molecules of bromine are supposed to unite directly with 2 mols. of water, with production of 2 mols. of bromo-peroxide of hydrogen, $2\text{H}_2\text{Br}_2\text{O}_2$, the oxygen of which is thus rendered more easily available for oxidising purposes, while the 2 mols. of hydrobromic acid are set at liberty or otherwise disposed of. By the second method, 2 mols. of bromine are supposed to combine directly with a given simple or complex carbon adjunct, and precisely in the same manner as 2 hydrogen molecules are wont to do, with this difference, however, that in the former case the recipient must always be a pure carbon adjunct, while in the latter case it may also be a hydrocarbon adjunct. By the third method, one of the 2 conspiring mols. of bromine is supposed to appropriate a molecule of hydrogen from a given simple or complex hydrocarbon adjunct, with formation of a molecule of hydrobromic acid, while the other molecule of bromine is made to step into its place.

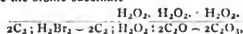
This hypothesis of a threefold mode of action, of which bromine is susceptible, appears to me so natural and reasonable, that I have not scrupled to adopt it as a safe and trustworthy guide while entering upon this new field of research. But before doing so, it is proper to state that the programme I intend to follow consists of two

parts: in the first part I shall expound the molecular changes that accompany the action of bromine on the water-salts of succinic, malic, and maleic acids; in the second part I shall elucidate the molecular changes that attend the action of bromine on the water-salts of pyro-citric acid. Let us then, without further delay, examine into the contents of the first part.

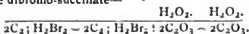
PART I.

On the Principal Molecular Changes that Accompany the Action of Bromine on the Water-Salts of Succinic, Malic, and Maleic Acids.

When the ordinary succinate is treated with bromine, the resulting substitution products, chiefly amounting to two, are the bromo-succinate—

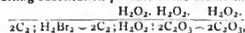


and the dibromo-succinate—

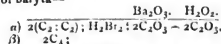


Both these compounds are engendered by the first method, consequently the accompanying molecular changes will consist, for the first compound, in the oxidation of the formous acid ally, at the expense of the newly-formed bromo-peroxide of hydrogen, and transposition of one of the hydrobromic acid molecules with the formylic alcohol principal, while the other is set at liberty; and, for the second compound, in the oxidation of the formous acid principal, and transposition of one of the hydrobromic acid molecules with the formylic alcohol ally, while the other is set at liberty.

When the ordinary malate is treated with bromine, the resulting substitution product is the bromo-malate—

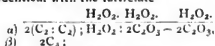


where the same explanation holds good. This view of the molecular structure of the aforesaid brominated derivatives is also fully borne out by experiment. Thus, when a solution of the bromo-succinate is heated with oxide of silver, the bromide of that metal is precipitated, and the solution is found to hold the ordinary malate, clearly showing that the metamorphosis is accomplished by the newly-formed hydrate of silver transposing with the formyl-bromide principal. Similarly, when a salt of the dibromo-succinate is boiled with water or excess of base, the bromide of the metal is formed, in some cases with elimination of both bromine molecules, in others of one only. For instance, the soda-salt is, under this treatment observed to resolve itself into 1 mol. of sodium bromide and 1 mol. of bromo-malate of soda; whereas the silver-salt deposits 2 molecules of bromide of silver, while the inactive modification of the tartrate of water remains in solution. The baryta-salt, on the other hand, is found to differ from the two former salts in this respect, that by the loss of 2 mols. of water the previously-formed bromo-malate of baryta becomes converted into the bromo-malate of baryta—



whence the bromo-malate of water may be easily obtained with the aid of sulphate of water. The same compound may also be procured by heating the bibromo-succinate, a molecule of hydrobromic acid being expelled at the same time.

It would, further, be interesting to ascertain whether the oxymalate, which Bourgoin professes to have realised by heating the bromo-malate with oxide of silver, is identical with the tartrate—

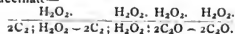


with which it shares the same formula.

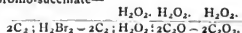
SYNOPTICAL ARRANGEMENT OF CHEMICAL FORMULÆ, COMPRISING THE ORTHO AND ISO MODIFICATIONS OF SUCCINIC, MALIC, AND MALEIC ACIDS, TOGETHER WITH THEIR BROMINE-SUBSTITUTED DERIVATIVES.

Ortho Series.

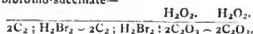
Ortho-succinate—



Ortho-bromo-succinate—



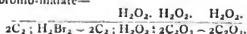
Ortho-bibromo-succinate—



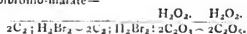
Ortho-malate—



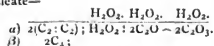
Ortho-bromo-malate—



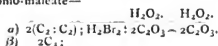
Ortho-bibromo-malate—



Ortho-maléate—

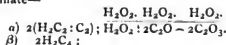


Ortho-bromo-maléate—

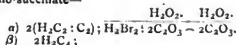


Iso Series.

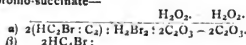
Iso-succinate—



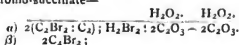
Iso-bromo-succinate—



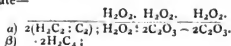
Iso-bibromo-succinate—



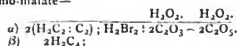
Iso-tribromo-succinate—



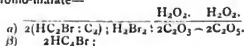
Iso-malate—



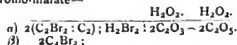
Iso-bromo-malate—



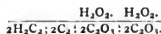
Iso-bibromo-malate—



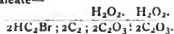
Iso-tribromo-malate—



Iso-maléate—



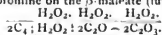
Iso-bromo-maléate—



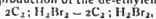
Iso-bibromo-maléate—



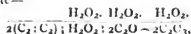
Reverting again to the dibromo-succinate, it deserves to be noticed that this substance may likewise be produced by the action of bromine on the β -maléate (fumarate)—



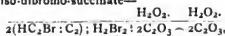
In this reaction the first method is held to come again into operation, with this difference only, that the second molecule of hydrobromic acid, instead of being disengaged, is instantly made to react upon the freshly-formed deacetyl-bromide, with production of the de-ethylen-dibromide—



which, in conjunction with the two oxalic acid constituents, composes the dibromo-succinate. On the other hand, and in striking contrast therewith, it is found that, when the α -maléate—

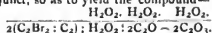


is treated with bromine, by far the greater portion merges into the iso-dibromo-succinate—



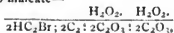
while the small quantity of ortho-dibromo-succinate is evidently due to the admixture of the β -maléate, into which a corresponding portion of the α -maléate had previously been converted.

In order to explain the accompanying molecular changes, I have recourse to the second method, according to which the bromine unites directly with the complex carbon adjunct, so as to yield the compound—

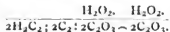


Subsequently, 2 mols. of water suffer decomposition, their oxygen uniting with the formous acid principal, while their hydrogen, by acting upon the dibrominated carbon

adjunct in conformity with the third method, gives rise to a molecule of hydrobromic acid, which, by transposing with the colligated alcohol, produces the iso-bromosuccinate as formulated above. When this substance is heated to 180°, it resolves itself into hydrobromic acid and the iso-bromo-malate—



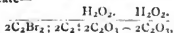
which may be regarded as a brominated derivative of the iso-malate—



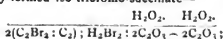
In this process the former constituent assumes the form of an acid carbon nucleus, while the residual bromomethylen constituent re-unites with that nucleus as an adjunct. At the same time, the system undergoes that species of typical metamorphosis which transfers it from the class of alcohol-conjugated water-salts to the class of hydrocarbon-conjugated water-salts.

I may mention here, *en passant*, that the iso-malate just alluded to was first obtained by Kämmerer from the iso-malate. This substance had been discovered in a silver-bath prepared for photographic purposes, and, on being treated with perchloride of phosphorus, gave rise to a chloride which, under the influence of water, resolved itself into hydrochloric acid and the iso-malate in question.

I may further state that the action of bromine in excess on the succinate is observed to give birth to the iso-bibromo-malate—



which may be a direct substitution-product of the iso-bromo-malate, or else a product of decomposition of a previously-formed iso-tribromo-succinate—



and I have no doubt that, ere long, and unless they have already been realised, the brominated derivatives of the malate and iso-malate will be added to our collection of curious and interesting chemical preparations. For their respective formulæ the reader is now referred to the annexed scheme (see preceding page).

(To be continued.)

NOTE ON THE COMPOUND OF STARCH WITH IODINE.

By E. SONSTADT.

SOME starch was kept for more than two months in a solution of salts containing more free iodine than the starch could take up. The iodised starch was then washed for a fortnight on a filter, by which time the water came through very nearly colourless; it was then further washed by decantation until the water was colourless after settling. The iodised starch thus prepared was black, and had little, if any, odour. A portion of it, air-dried, was found to contain 3·2 per cent of iodine. Another portion was then heated in an oven for a long while at a temperature somewhat higher than that of a water-bath. While drying, it smelt perceptibly of iodine, but, when thoroughly dry, it was perfectly free from odour, and the colour remained black. This stove-dried compound, heated in a closed tube, gave off no trace of free iodine, but a small quantity of a yellowish vapour came off, of a pungent odour, attacking the eyes, and condensing in the cool part of the tube in drops. The heat was then raised to redness, and the charcoal formed examined for iodine, which it proved to contain.

The stove-dried compound is extremely stable, and the ordinary reagents attack it very slowly; it could not be analysed by treatment with solution of thiosulphate of sodium, or of chlorine. A solution of the former, in excess, failed to decolourise it after a week's treatment, with frequent shaking. It was prepared for analysis by moistening it with a strong solution of hydrate of sodium, and heating to redness, and the iodine was estimated in the solution of the residue by chlorine-water. It contained 3·2 per cent of iodine, the same percentage of iodine as was contained in the air-dried specimen.

Another portion of the stove-dried compound was charred at a gentle heat, continued for about an hour, in a covered crucible, and at the last the heat was raised for about ten minutes to low redness. The charcoal proved, on analysis, to contain 3·2 per cent of iodine, equal to 19·64 per cent of the iodine contained in the specimen before its conversion into charcoal. Thus, about four-fifths of the iodine contained in the strongly-dried iodised starch is driven off (though not as free iodine) by charring at a red heat, and a fifth of the iodine remains with the charcoal formed.

ON THE ESTIMATION OF SULPHUR IN PIG-IRONS, &c.

By CHARLES H. PIESSE,
Public Analyst for the Strand District.

A SIMPLE and ready method of estimating the sulphur in pig-irons and steels, and one requiring but little attention, is as follows:—

Place in a beaker of about 300 c.c. capacity about 3·5 to 4 grms. of the sample, in drillings (weighed to within 0·01 grm. will be sufficiently accurate), and pour upon them 35 to 40 c.c. of aqua regia, consisting of 1 part HNO_3 with 2 parts HCl , maintaining the proportion of 10 c.c. of the mixed acids for every 1 grm. of the metal, keeping the beaker covered as well as possible with a clock-glass. After the first violence of the action has subsided, boil the liquid for a few moments until the whole of the iron is dissolved, then transfer the solution, with as little washing as may be, to a porcelain basin, and evaporate as nearly as possible to dryness on a water-bath. Treat the residue with some concentrated HCl , add about an equal bulk of water, and then filter. To the filtrate add a considerable excess of BaCl_2 solution, allow to stand for about twelve hours; filter, and weigh the precipitated BaSO_4 with the usual precautions. Multiply the weight of BaSO_4 found by 13·724, and divide the product by the weight of the iron employed; the result will be the percentage of S in the sample analysed.

Laboratory, 303, Strand, London.

NOTE FROM THE LABORATORY OF CHARING CROSS HOSPITAL.

By THOMAS BOLAS.

On the Ferrous Sulphate Test for Nitric Acid, and its Employment as an Approximate Indicator of the Amount of Nitrates in Potable Water.

In performing this test, it is more advantageous to float the liquid under examination on a solution of ferrous sulphate in oil of vitriol, than to follow the usual method of floating an aqueous solution of ferrous sulphate on the suspected fluid mixed with oil of vitriol. The sulphuric solution of ferrous sulphate is best prepared by mixing oil of vitriol with 10 per cent (by volume) of a cold saturated solution of ferrous sulphate, and heating the mixture sufficiently to decompose any of the olive-green compound which may arise from the accidental presence of nitric acid in the oil of vitriol employed. When cold, the

colourless solution is ready for use, and it may be labelled "Nitric Acid Test." It is convenient to introduce the fluid to be tested by means of a pipette having the delivery-end bent once at a right angle, and the charged pipette should be placed against the side of the test-tube, about an eighth of an inch above the surface of the vitriolic solution, and then the finger should be removed from the upper end of the pipette to allow the liquid to flow. It is, moreover, necessary to use a pipette having a rather small opening, otherwise the rush of fluid causes considerable agitation.

By adopting this modification of the well-known sulphate of iron test, two principal advantages are attained—in the first place, it is unnecessary to test the sulphuric acid each time it is used, and, in the second place, the loss of time required to cool the usual mixture is avoided; moreover, the "nitric acid test," unlike aqueous ferrous sulphate, remains clear and always ready for use.

Attempts were made to estimate the nitric acid in potable waters by comparing the tints produced on floating them on "nitric acid test" with those produced when standard solutions of nitre are similarly treated, but in this case so much depends on delicacy of manipulation in pouring on the lighter fluid, that the results obtained were not so constant as might be desired, but if the water to be tested is carefully run in with a pipette as above described, and if the standard solutions of nitre are similarly treated, results are obtained which, in the course of a few seconds, indicate the approximate amount of nitrates contained in water. In cases where the amount of nitrates is small, a beaker may be advantageously substituted for a test-tube, and, in any case, the vessel in which the testing is performed should be steadily fixed during the operation.

The salt which separates on cooling the hot "nitric acid test" is under examination.

Charing Cross Hospital,
Nov. 10, 1873.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopaedic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."

Note. All degrees of temperature are Centigrade, unless otherwise expressed.

Moniteur Scientifique, du Dr. Quesneville,
October 1873.

Modern Progress of Industrial Chemistry.—Aimé Girard.—A popular address delivered at the Lyon meeting of the French Association for the Advancement of Science. It has been already noticed in the *CHEMICAL NEWS*.

Part Played by Septic Agents in the Animal System.—Fernand Papillon.—A physiological paper of considerable interest.

Theory of Tanning.—M. A. Reimer.—A continuation of the treatise which we have already noticed.

On Atmospheric Ozone.—M. Ebermayer.—An essay on the causes which promote the spread of epidemics, and the precautions to be adopted for their restriction.

Volumetric Determination of Bismuth.—MM. Buisson and Ferray.—The method in question is based upon the complete precipitation of bismuth by iodic acid in an acetic solution. The iodate of bismuth is a white anhydrous powder, $\text{Bi}_2\text{O}_3 \cdot 3\text{IO}_3$, insoluble in water and acids. This method is applicable to the determination of

all compounds into which bismuth enters. The assay of a sample of subnitrate of bismuth is made by dissolving half a gramme of this salt in a few drops of nitric acid, and diluting slightly with water. The liquid is saturated with bicarbonate of soda until a slight permanent precipitate appears. This precipitate is re-dissolved by acetic acid in excess so as to hinder the partial precipitation of bismuth on the subsequent addition of water. The liquid is then boiled and filtered to separate the iron and oxychloride of bismuth which may be present. To the filtrate we add 25 c.c. of iodic acid, and water enough to make up 250 c.c. It is well stirred, and after being allowed to settle for a few moments the liquid is poured upon a dry filter. To 100 c.c. of the clear liquid we add dilute sulphuric acid and iodide of potassium, so as to decompose the iodic acid which has not been consumed, and to redissolve the iodine set at liberty, which may be easily recognised when the liquid no longer contains greyish floating particles of iodine. The following equation explains this reaction:— $\text{IO}_3 + 5\text{KI} + 5\text{SO}_3 = 5\text{SO}_2 + 5\text{KI} + 6\text{I}$. Into the liquid containing the iodine there is dropped, by means of a burette graduated into tenths of a c.c., a solution of hyposulphite until the yellow tint of the iodine disappears. The addition of starch is needless, for the disappearance of the yellow tint is a more sensitive indication than the disappearance of the blue colour of the iodide of starch. The difference of the value found on adding upon iodic acid alone, and upon iodic acid after preliminary precipitation with a known weight of pure bismuth renders it possible to calculate the amount of bismuth contained in the sample under examination. It is preferable to express the result as metallic bismuth rather than as subnitrate, the composition of which is still not well known. The authors believe that it contains 68.94 per cent of the metal. If lead or baryta are present they must first be removed as sulphates. Tin and antimony found alloyed with bismuth are converted into insoluble stannic and antimonious acids by treatment with nitric acid. The reagents employed must be free from chlorine, and the iodide of potassium must contain no iodate of potassa. To detect the presence of this impurity dissolve 1 gm. of the sample in 11 c.c. of water; adding a few drops of pure hydrochloric acid, and shaking up with chloroform. If this latter body remains colourless the iodine is pure. The standard solution of iodic acid is prepared by dissolving 30 grms. of the crystalline acid in 1 litre of distilled water, and titrating with the aid of pure bismuth. The solution of iodide of potassium is saturated. The solution of hyposulphite is sufficiently strong when 30 to 40 c.c. serve to oxidise the iodine liberated from 10 c.c. of iodic acid.

Bulletin de la Société Française de Photographie,
No. 9, 1873.

Notice on Heliochromy.—M. de Saint Florent.—The author has succeeded in producing heliochromic proofs, whose colours have the closest relation with the natural colours. Landscapes have been obtained in this manner in the camera, though the colours were rather faint. He steepes a sheet of paper of fine texture in—

Nitrate of silver	20
Distilled water	20

To which, when dissolved, is added—

Alcohol	100
Nitric acid	10

When the paper is dry it is again plunged into—

Hydrochloric acid	50
Alcohol	50
Nitrate of uranium	1

It is necessary to dissolve previously in the hydrochloric acid a little zinc-white, say from 1 to 2 grms. On removal from the bath the paper is exposed to sunlight until it turns a violet-blue. It is then, after drying, plunged anew first into the silver, and then into the hydrochloric bath.

The operations are repeated till a paper is obtained of an intense violet-blue. When quite dry it is placed in the following bath:—Water, 100; acid nitrate of mercury, 4 to 5 drops. The paper is left in this bath five to ten minutes and dried. It is then exposed under a coloured glass, and there is obtained in thirty to forty seconds a proof with a white ground and all the colours of the model. The colours are brighter, and the speed as great if to the foregoing bath be added—

Bichromate of potash (saturated solution) ..	2
Sulphuric acid	2
Chlorate of potassa	1

To fix the image approximately it is washed in much water, and then plunged in—

Ammonia	5
Alcohol	100

The paper is washed and plunged in a saturated solution of an alkaline chloride. After a further washing the proof resists diffused light for a long time. More rapid action is obtained if the chloride of silver paper is allowed to blacken under violet or blue glasses. If on withdrawal from the bath of nitrate of mercury the paper is exposed under a coloured glass, and glasses of different colours are interposed between it and the sun, the proof comes up more rapidly under yellow, green, and red glasses than under blue and violet. To produce landscapes with the camera it is necessary to prevent as far as possible the action of diffused light, and for this purpose to adapt in front of the objective a cardboard cone of suitable length. The time of exposure, with a Darlot's objective of 0.2 metre focal distance, is from fifteen minutes to one hour, using the largest diaphragm, and operating in sunshine.

Proofs with Fatty Inks.—An account of certain specimens sent by M. Rodrigues of the Polytechnic School of Lisbon.

An Account of the Process for Photo-zincography as Employed by the Photographic Section of the General Direction of Geographical Works of Portugal.

—The mixture used in the preparation of the plates was—

Water	1000	grms.
Gum arabic	40	"
Sulphate of copper ..	2	"
Gallic acid	5	"
Nitric acid	0.5	"

Dry Collodion Process.—A. de Constant.—The author indicates the conditions necessary for successful work by this process. He recommends the employment of a special collodion made with a cotton prepared at a high temperature, or else already old; to find a covering which whilst acting mechanically to preserve the porosity of the collodion contains also a chemical agent which may intervene usefully for the preservation of the layer, and may aid in the combination of the development; to compose the preparation chosen for covering, so that the dry layer may not contain any element of alteration, and may remain in good condition for some months; to find a means of softening the dried layer, and of restoring to it a sufficient permeability that the developing solution may penetrate and exert its action equally and completely, without making rapidly a capital question, to abridge the exposure as much as possible. Into each of these points the author is about to enter in detail.

Stereoscopic Proofs on Glass, and Various Procedures.—Count Ludovico de Courten.—The author prefers plates preserved with tannin, which he prepares exactly as directed in his "Manuel Pratique." He gives procedures also for cementing positive proofs upon cardboard, for securing solidity in the varnish applied to negative proofs, and for producing moonlight effects.

The Ordinary Wet Collodion Process.—M. Th. Sutton.—The author has been experimenting in order to ascertain with precision the best respective proportions for the soluble iodide and bromide in the wet collodion pro-

cess. He concludes that a collodion for great rapidity ought to be liberally iodised, and to contain a fair proportion of bromine. The strength of the nitrate bath should not exceed 8 per cent. The bromide of silver he finds is exceedingly sensitive to light without the presence of free nitrate, and this will be the starting-point for a great improvement in the art. The author makes use of a bath prepared more than ten years ago, and which has been in use ever since. He employs pure neutral re-crystallised nitrate, and adds from time to time bicarbonate of soda to the bath, exposing it for a day to the light. The carbonate of silver is then filtered off, and the bath, slightly acidulated with nitrate of silver, is in excellent condition.

Reimann's Fürber Zeitung, No. 36, 1873.

The Exhibition in Vienna.—Haahl and Co., of Molenbek (Belgium), exhibit a model of an apparatus for extracting the grease from wool by means of bisulphide of carbon. Schlumberger, of Brussels, exhibits xanthin, artificial indigo, and other coal-tar products. There are receipts for colours upon plush, scarlet, ponceau, crimson, garnet, and medium garnet. The "scarlet spirit" used as a mordant in these formulae is directed to be made from 14 lbs. tin crystals, 24 lbs. bichloride of tin, and 50 lbs. of hydrochloric acid, fuming, but free from iron. Only the clear part of the mixture is to be employed. There is an article on the arrangement of steam pipes in dye-works, which contains nothing new to English dyers. Next follow receipts for dyeing cotton a chamois; cotton-yarn a rose by means of annatto and safflower extract; mixed goods a grey; wool a drap, a stone, and a reseda. Reichardt has found, at Jena, sausages dyed with magenta. In this case alcohol extracts the red colour. The so-called "antimony-blue" has been going the round of the technological papers.

No. 37, 1873.

This number contains a full description, with illustration, of Haubold's machine for washing yarn. There are receipts for garnet, light, medium, and dark green, and silver-grey on plush, porcelain white and lemon-yellow on wool. Catechu and sanders are recommended as an addition to the copperas vat in order to save indigo. Next follow prescriptions for steam-printing colours, chiefly olives.

No. 38, 1873.

The New Indigo Vat.—Schützenberger and De Lalonde.—It is known that the low stage of oxidation of sulphur obtained on the reduction of sulphurous acid with zinc dissolves indigo. On this reaction the following procedures for dyeing and printing with indigo are founded:—To prepare the reducing liquid a solution of bisulphite of soda at 35° B. is brought in contact with sheet zinc in a closed vessel, of which the liquid should occupy only one-fourth. After the lapse of an hour the zinc is precipitated from the clear liquid by means of milk of lime. It is then diluted and decanted or filtered with exclusion of air. The clear liquid is then poured upon the ground indigo, with the addition of the needful soda and lime. 1 kilo. of indigo yields in this manner a very concentrated vat of 10 to 15 litres. Cotton is dyed cold, and wool with the aid of heat. A vat is filled with water, and a suitable quantity of the above indigo mixture introduced, when the dyeing can be performed at once. The excess of the low sulphur acid dissolves the froth which appears on the surface. During the process of dyeing further quantities of indigo can be added as required. Cotton can be rapidly and easily dyed in this manner; and in the case of wool the dyer escapes the many disadvantages of the hot vat, and obtains brighter and clearer shades. To print a fast blue the alkaline solution of the reduced indigo is printed on with an excess of the reducing agent, aged for twelve to twenty-four hours, washed, and soaped. In comparison with the old process there is a saving of indigo to the extent of 50 to 60 per cent.; the shades are richer and the impressions sharper. The colour requires no subsequent

treatment, and can, therefore, be printed on simultaneously with most other colours.

Cotton Dyeing.—There are receipts for a deep rose, a safflower-scarlet, an olive, and a violet on cotton yarns.

Alpaca and Mixed Goods.—The editor gives receipts for a cochineal scarlet, a dark brown, and a black.

Wool Dyeing.—There is a receipt for a Nicholson blue. Woolen piece goods are directed to be worked in a solution of 1 per cent of the colour, and 1 per cent of sulphate of zinc, while the temperature is slowly raised to a boil, which is maintained for an hour. The cloth is taken out, cooled, rinsed in cold water, and placed in a beek containing 2 per cent (on the weight of the goods) of sulphuric acid, and 1 per cent of sulphate of zinc. A single turn in this bath suffices to raise the colour.

Plush Dyeing.—There are receipts for a dahlia, and a magenta and a blue.

Silk Dyeing.—There are receipts for a rose and a sky-blue, which offer nothing remarkable.

Argentine Effect.—Jacobsen stirs up commercial tin (zinc?) powder with a solution of albumen to a paste, which is then printed. The goods are steamed and steeped in a solution of bichloride of tin. The tin dissolves out the zinc, and is deposited in its place. The goods are washed, dried, and run through a glazing machine which polishes the tin. It is proposed—rather grotesquely—to dye drabs and browns with an extract of green walnut shells! Sulphide of cadmium as an undried precipitate, is found to be a good (but expensive) yellow colour for soaps. A permanent red ink is prepared by rubbing up carmine with a solution of soluble glass to the consistence of good writing ink. The writing dries swiftly, and is as bright as a mirror. This ink must be preserved from contact with air. Solution of gum arabic is improved by adding 2 parts of sulphate of alumina to 250 of a solution of gum, made in the proportion of 2 parts of gum to 5 of water. Gum thus prepared is sold as vegetable glue, and serves to cement together surfaces of metal and glass. Dufrené to prevent mouldiness steeps the articles in a dilute solution of tannin, and treats them with a solution of bichromate of potassa till a brown colour is produced. He then washes and dries. (It must be remembered that this process is not applicable to articles of food.)

Revue Hebdomadaire de Chimie Scientifique et Industrielle, par Ch. Mène, No. 38, 1873.

The greater part of this number is again filled up with non-chemical matter. There is a notice of Siemens's gas-furnaces, which are no longer a novelty, and a short paper on the new process for the manufacture of alkali as worked by M. Solvay, at Couillet, in Belgium. This process, founded on the decomposition of the chloride of sodium by the bicarbonate of ammonia, has been already in operation at Couillet for some time, and now furnishes about one-fourth of the soda actually consumed in Belgium. Hence it is evident that M. Solvay has overcome the difficulties which former inventors such as Turech, Schlessing, and Roland found insurmountable. M. Solvay has received a diploma of honour at the Vienna Exhibition.

No. 39, 1873.

This number again contains no chemical matter.

Revue Scientifique de la France et de l'Etranger, October 18, 1873.

History of the Chemical Theories of Digestion.—Claude Bernard.—Prof. Claude Bernard, in his course of lectures on general physiology, gives an account of the various theories of digestion entertained by men of science from Hippocrates downwards. The eminent Greek physician considered digestion as a cooking process. Galen maintained the existence of three kinds of digestion, the first performed in the stomach, the second in the duodenum,

and the third in the liver; a view taken in later times by Servetus and Drake. Plistonius, a disciple of Protogoras, identified digestion with putrefaction. Hilmon regarded digestion as fermentation, and divided it into six kinds, a view in which he was followed by Sylvius, Willis, Boyle, and others. The mechanical theory of Borelli, Berhaave, and Pitcairn considered digestion to be mere trituration, a view which as far as animal food is concerned was experimentally refuted by Reaumur. This naturalist introduced into the gizzards of birds portions of meat enclosed in perforated metals tubes. On killing the bird after some time the meat was found to have been dissolved. Seeds, however, enclosed in a similar manner resisted the digestive process. Spallanzani succeeded in withdrawing gastric juice from animals, and by its means performed artificial digestion outside the living body. The author concludes with a notice of the observations made upon the celebrated Alexis St. Martin.

October 25, 1873.

This number contains no chemical matter.

NOTES AND QUERIES.

Notes on the Utilization of Sewage.—(From the "Report of the Main Drainage Committee for 1864," vol. 457).

2165. (To Mr. West.) Can you give us any information of the relative cost of the carriage of any substance, such as clay, in a cart, or by suspension in water, by means of pumping?—That will make no difference at all, because we are pumping all the China clay in St. Austell, which is about 300,000 tons a year, and that is thicker than the mud of the Thames, and it does not interfere with the valves at all as long as it is in a liquid state. We pump the mineral water in some of the mines also; half of that is entirely what we call mud.

2175. Does your estimate of the price of pumping depend upon a given price of coals?—Yes, entirely so. I calculate the coals would cost £1 per ton, which is quite sufficient.

2178. (To the same.) You have stated that the liquid clay is conveyed in pipes by gravitation; what distance is it so conveyed?—From two to three miles in several places. I have one gentleman close by my land now, about two miles off, who is a large clay merchant, and he tells me that he saves something like £800 a year by carrying the clay in this manner.

2209. (To Mr. Hocking.) You stated that if the coal were dearer as between your average of 17s. and 20s., that would increase the cost of lifting; are there not other elements besides coal, such as wear and labour?—We have calculated for labour the price generally paid in this neighbourhood, but the increased price for lifting would not increase in the same ratio as the price of coal increased.

2210. Now would the wear and tear of the engines?—No.

2211. Then should we have simply to add the cost of coal?—Yes.

2212. What is the maximum height to which you can lift the sewage?—It would be lifted 300 feet in one lift, but I do not think it would be advisable to lift it to that height in one time.

2213. Would it require much stronger pumps for that height?—Yes.

2214. You would require other engines, and another reservoir at the next lift, would you not?—Yes.

2215. (To Mr. Johnson.) Upon what data do you ground your opinion that the sewage will not answer when applied to corn crops?

—The advantage of sewage, I take it, to grass, is to be divided into two portions; first, the advantage of applying so much pure water; and, secondly, the application of the various matters which are chemically suspended in, or chemically combined with, that water in the case of sewage. I take it that, in most cases, if the same bulk of water were applied to grass land, it would do a great deal of good in the majority of instances in suitable soils; but with regard to the cereals you do not want moisture; the driest climates are the best for the most valuable of these cereals, and therefore when you add water to corn land it is adding what the land does not need.

2216. But does not corn land require the fertilizing properties of sewage?—Yes; but then I take it that the bulk of water which would be necessary to carry those ammoniacal matters, and that small amount of phosphate of lime which is contained in the sewage, is so great, that the water would be injurious to the crops, perhaps a greater extent than the chemical matters would do good to the land.

2217. (To Mr. Ellis.) Do you know of any chemical manufacture at Alnwick?—I cannot say as to that. At Edinburgh they put on considerably more than £100 worth of sewage to the acre, and they only get £20 worth of grass. That is a great failure.

2218. (To Mr. Bateman.) Have you found any inconvenience from the application of the sewage?—There has been no inconvenience; the most beautiful application of sewage that I have seen is at Carlisle.

MEETINGS FOR THE WEEK.

THURSDAY, 20th.—Chemical, 8. E. Davies, "On the Chemical Properties of Ammoniated Ammonia Nitrate." Dr. W. J. Russell, "On the Action of Hydrogen on Silver Nitrate."

Now Ready, Price 5s.

Milk-Analysis.—A Practical Treatise on the Examination of Milk (including Cream, Butter, and Cheese). By J. ALFRED WAKLEY, M.R.C.S., Corresponding Member of the Royal Bavarian Academy of Sciences, Public Analyst for Bucks.
London: TRUBNER and CO., Ludgate Hill.

Chemical Technology, or Chemistry in its Applications to the Arts and Manufactures. By THOMAS RICHARDSON and HENRY WATTS. Second Edition, illustrated with numerous Wood Engravings.

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South London School of Chemistry and Pharmacy. Director—Dr. JOHN MUTER, F.C.S.

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Chemistry (Inorganic) 10 a.m. Materia Medica . . . 4 p.m.
(Organic) 2 p.m. Pharmacy . . . 2 p.m.
Botany (Structural) 11 a.m. Classics (Junior) . . . 9 a.m.
(Systematic) 3 p.m. (Senior) . . . 4 p.m.
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TESTIMONIALS.

19 and 21, Paternoster Row, London, May 15th, 1872.
Mr. NICHOLLS.—Dear Sir,—I tried your Application for total deafness of the left ear and it took it away. My daughter tried it for toothache—same result.—Yours truly, B. WILLIAMS, Music Publisher.

North Road, Highgate, Jan. 9th, 1873.
Mr. NICHOLLS.—Dear Sir,—I tried your Application for Gout, from which I have long suffered. I have not had the slightest return of it. With many thanks, I remain, yours truly, WILLIAM AYTON.

45, Tavistock Terrace, Upper Holloway, 10th April, 1873.
Dear Sir,—Your Cloth has been very beneficial to me. Last Thursday I sent your address to Dr. Boulton, of St. John's Hall, Highbury, and I now send my daughter for a Cloth for an old friend friend of mine—a Gout Cloth.—Yours truly, W. MAWCA.

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SUPPLEMENT TO THE CHEMICAL NEWS.

Vol. XXVIII. No. 729.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, November 6, 1873.

Dr. ODLING, F.R.S., President, in the Chair.

THE minutes of the previous meeting having been read, Messrs. Walter Odling and C. W. Vincent were formally admitted Fellows of the Society.

The donations to the Society were then announced by the Secretary, and the following names read for the first time—Messrs. Charles L. Field, Walter T. Goolden, B.A., B. W. Richardson, F.R.S., Donato Tommasi, Edgar Beckett Truman, Thomas H. Davies, William Masters, A. Campbell Dixon, James Baynes, Thomas Jamieson, Robert Williamson, Charles James Hislop Warden, Francis Jones, Sydney Knowles Muspratt, Felix M. Rimmingtons, Edward Cleminshaw, Samuel Herbert Cox, and Arthur B. Kitchener.

For the third time—Messrs. Edward Collens, George Bult Francis, William Edward Porter, John Turner, and William Charles Young, who were balloted for and duly elected.

Dr. ODLING said it was not customary for the President to address the Fellows at the first meeting of the session, but he could not help saying a few words of welcome and congratulation on their taking possession of their new rooms, and they might regard the assistance they had received from the State, unaccompanied as it was by State control, as some recognition of the advantages of scientific research to the national welfare, and as tending to the mental and moral cultivation of the people. It was necessary for them to have some place of meeting, and it would be impossible for them to provide such handsome rooms as they had now, indeed to provide rooms at all would be a very serious inroad on their funds. He might mention two new features—one the commodious store-room for the spare numbers of their journal, and the other the laboratory adjoining the meeting-room, the primary use of which would be for giving experimental illustrations in connection with the papers brought before the Society. After alluding to the various benefits to be derived from their meeting together, the speaker said that chemical science treated of things that could be handled, and phenomena which could be observed, and the use of the laboratory was offered to those who brought new facts before the Society to illustrate those facts, for we all know the great delight and interest chemists take in witnessing such experiments. With regard to the financial aspect of the matter, they had incurred considerable expense, although the Government had given the gas-fittings and the new book-shelves in the library; however, all that was useful in the old rooms had been removed here, and utilised in one way or other; even the old historic seats, which were formerly those of the Royal Society, formed part of the benches in that room. He could not but tell the Fellows that it was owing to the great exertions of the Junior Secretary, Dr. Russell, that they were enabled to remove to their new rooms in time for this meeting, and throughout the arrangements they had met with the greatest courtesy and kindness both from Mr. Barry, the architect, and also from the Clerk of the Works.

The first paper, "On the Optical Properties of some Modifications of the Cinchona Alkaloids," by D. HOWARD, was read by the author. After enumerating the various observations that had been already made on this subject, he drew attention to the approximate relation between the deviation caused by quinine and cinchonin and the alkaloids from which they are derived; thus the mean of the specific rotary power of quinine and quinidin in alcoholic solution is 47° to the right, and that of cinquin, corrected for its combined water, 41° , whilst, in aqueous sulphuric acid, they are 205° and 194° respectively. A similar approximation is found to be the case with cinchonin as compared with cinchonin and cinchonidin. The action of nascent hydrogen on the alkaloids in acid solution gives rise to compounds which Schützenberger regards as differing from the original compound in containing 1 atom more water; the author, however, is inclined to doubt this, as no evolution of hydrogen occurs when cinchonin or cinchonidin is treated with zinc and dilute sulphuric acid until a considerable excess of the acid has been added: the optical properties of the bodies formed are very similar to those of quinine and cinchonin. The author then proceeded to describe the method of preparation and optical properties of the various ethyl bases produced by the action of ethyl iodide or bromide on the cinchona alkaloids: the rotation produced by the salts of the ethyl bases is in most cases very nearly proportional to that which would be given by a salt of the original alkaloid, equal in amount to that contained in the new compound.

THE PRESIDENT thanked the author in the name of the Society for his interesting memoir, and hoped he would take advantage of his great opportunities, and give the Society some further results of his experiments.

Dr. FRANKLAND had listened with much interest to Mr. Howard's account of the alteration produced on the polarised ray by the effect of combination. It was a matter of great importance to accumulate results on this subject, so as to endeavour to ascertain what circular polarisation means, chemically speaking. The alteration in the intensity is not only produced by combining two substances of opposite rotary powers, but sometimes also by the combination of a rotary body with a neutral one. He would like to ask the author whether he had ever observed amongst the cinchona alkaloids an instance in which combination with an indifferent body had caused a reversal of the rotation of the polarised ray.

Dr. WRIGHT suggested to the author that he should determine the heat of combustion of some of these isomerides, to see whether there was any relation between the heat evolved and the rotary power, somewhat similar to that which had been observed in many volatile bodies between the heat of combustion, and the boiling-point.

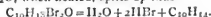
Mr. HOWARD replied that he had not found any instance in which inversion of the rotary power took place where the altered compound could be re-converted into the original substance. In dealing with bodies of so complex a nature and so delicate a structure, which were so very easily destroyed, the difficulty was to find cases where they give satisfactory results at all.

Dr. C. R. A. WRIGHT then read a "Preliminary Notice on the Oils of Wormwood and Citronella." The portion of oil of wormwood boiling between 195° and 200° , and termed by Gladstone *absinthol*, $C_{10}H_{16}O$, when treated with phosphorus pentasulphide, is decomposed, a hydrocarbon being produced which boils at 170° to 180° , and a yellowish oil boiling at 230° and upwards. The hydrocarbon, after purification, boiled at about 176° , and, on analysis, appeared to be cymen, produced in the reaction—



The yellowish liquid boils at about 235° , and is chiefly *thio-cymen* or *cymyl-sulphhydrate*, identical with that recently obtained by Fiesch from camphor. Oil of citronella, when distilled, yields an unstable body of the formula

$C_{10}H_{18}O_2$, which unites with bromine, and the product, $C_{10}H_{18}Br_2O$, when heated, splits up thus—



The resulting cyment is apparently identical with that already known.

The PRESIDENT, having thanked the author for his communication, called on Mr. W. F. DONKIN to read his paper "On the Estimation of Nitrates in Potable Waters." This process is founded on the reaction that a nitrate in the presence of chlorides, when treated with phenol and sulphuric acid, gives a reddish solution, which, on the addition of an excess of ammonia, changes to a more or less decided blue; this gradually becomes more intense on standing. The water under examination is compared with a standard solution of potassium nitrate containing a known quantity of the salt; these are treated in a precisely similar manner. The process is capable of accurately determining the amount of nitrates present to within 1 part in 4,000,000 of water; it is, however, necessary to closely observe certain details given in the paper, in order to insure this result, slight variations in the manner of conducting the operations or in the quantities of the reagents employed producing corresponding variations in the depth of tint obtained.

Dr. ODLING said the determination of the amount of nitrates in water was a subject of interest to many of the Fellows present, and if an easy process for determining ammonia could be devised, it would be a boon to water analysts all over the country.

Dr. FRANKLAND remarked that, although much attention had been devoted to the determination of nitrates and nitrites in waters, there was still room for another process. The aluminium process answered admirably with a water which gave a large residue with comparatively little organic matter, and the mercury and sulphuric acid process when much nitrate was present, but it was not trustworthy when the amount of the latter was very small. In those cases where there was a large residue and a large amount of organic matter, he hoped the new process might prove available, but he thought the accuracy of the method had not been pushed far enough. The mercury process fails when the amount present in the water is less than 0.01 in 100,000. He would like to ask the author whether he had made any experiments on such minute quantities.

Mr. W. THORP congratulated Mr. Donkin on obtaining such good results with a colour process, the difference detected being about 11 per cent on the total quantity, whilst with the Nessler test it required a practised eye to detect a difference of 21 per cent. He thought, when the amount of nitrates was but small, that the mercury and sulphuric process was rendered thoroughly satisfactory by adding a known quantity of a standard solution of a nitrate to the water previous to evaporation, the object being to obtain a measurable quantity of gas, thus overcoming the difficulties which were merely mechanical.

Mr. DONKIN, in answer to Dr. Frankland, said he had not made further experiments on very small quantities of nitrates; he had examined a water containing a large amount of residue, which yielded a faint blue tint, but had not tested for nitrates by any other process. One of the great advantages of the method was its rapidity; half-a-dozen determinations could easily be made in a morning.

The Secretary then read a "Note on the Action of Iodine Trichloride upon Carbon Disulphide," by Mr. J. B. HANNAY. The author finds that the result of the action of pure carbon disulphide on iodine trichloride is represented by the equation—



and suggests that the different results obtained by Weber were probably owing to the iodine trichloride he employed containing monochloride. The author prepares the pure trichloride by passing chlorine over iodine in a retort, with occasional agitation, until a reddish yellow solid is produced. Heat is then applied, and a yellow sublimate of the trichloride is formed in the receiver, whilst mono-

chloride is left behind; this is again chlorinated, and again sublimed, until the whole is transformed into the trichloride.

The PRESIDENT, after expressing thanks for Mr. Hannay's paper, adjourned the meeting until Thursday, the 20th of November.

ROYAL INSTITUTION OF GREAT BRITAIN.

General Monthly Meeting, November 3rd., 1873.

GEORGE BUSK, F.R.S., Treasurer in the Chair.

The Secretary announced the decease of Sir Henry Holland, the President, on October 27.

Henry Adolphus Focking, and Major John Andover Wood were elected Members of the Royal Institution.

The special thanks of the members were given to Charles Woodward, F.R.S., for his present of his work on the "Polarisation of Light," and of much valuable apparatus illustrating the subject; and also to William Salmon, M.R.I. for his donation of ten pounds for the promotion of scientific research in the Royal Institution.

The presents received since the last meeting were laid on the table, and the thanks of the members returned for the same.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, October 7th, 1873.

E. W. BINNEY, F.R.S., F.G.S., Vice-President, in the Chair.

Mr. SAMUEL BROUGHTON was elected Treasurer of the Society in place of the late Mr. Thomas Carrick.

"Atmospheric Refraction and the Last Rays of the Setting Sun," by DAVID WINSTANLEY.

It is recorded in the Proceedings of this Society that a letter dated from Southport, and written by Dr. Joule, was read at the meeting held on the 5th October, 1869. In that letter it is remarked that "Mr. Baxendell noticed the fact that at the moment of the departure of the sun below the horizon the last glimpse is coloured bluish-green." Dr. Joule also observes that on two or three occasions he had himself noticed the phenomenon in question, and that "just at the upper edge where bands of the sun's disc are separated one after the other by refraction, each band becomes coloured blue just before it vanishes."

During the past eighteen months the writer, from his residence in Blackpool, has had frequent opportunities of observing the setting sun, and has noticed the phenomenon of the final coloured ray certainly more than fifty times. To the naked eye its appearance has generally been that of a green spark of large size and great intensity, very similar to one of the effects seen when the sun shines upon a well-cut diamond. The colour, however, is by no means constant, being often, as in the case of Mr. Baxendell's observation, bluish-green, and at times is mentioned by Dr. Joule, quite blue. The period of its duration, too, is likewise variable. Sometimes it lasts but half a second, ordinarily perhaps a second and a quarter, and occasionally as much as two seconds and a half.

When examined with the assistance of a telescope, it becomes evident that the green ray results at a certain stage of the solar obscuration, for it begins at the points or cusps of the visible segment of the sun, and when the "setting" is nearly complete extends from both cusps to the central space between, where it produces the momentary and intense spark of coloured light visible to the unaided eye.

From the fact of the green cusps being rounded I apprehend that irradiation contributes to the apparent

magnitude of what is seen. The range of colour, too, as seen in the telescope, is more varied, and the duration of the whole phenomenon more extended, than when the observation is made only with the naked eye.

Of the objective nature of the phenomenon it is needless to offer evidence; for it needs to be but seldom seen to preclude the idea of an optical illusion. That the waters of the ocean have nothing to do with the production of the colour is made manifest by its visibility when the sun "sets" behind the edge of a well-defined cloud. On the 14th and 15th of June, for instance, it was seen at upper contact of the solar limb with clouds. On the earlier date in question a thin band of cloud stretched across the setting sun, and under a power of fifteen diameters the green effect was seen at upper contact with the cloud, and again at final disappearance below the horizon. On the later date it was again seen at upper contact with each of several filaments of cloud, and again at final disappearance. And on several other occasions the writer has observed the effect when the disappearance of the sun has taken place at an elevation of six or eight degrees behind a heavy bank of clouds.

Respecting the increased range of colours seen when the phenomenon is observed with telescopic aid, I may mention that on the 28th of June the sea was calm and the sky quite cloudless at the setting of the sun. Of the final coloured rays fifteen diameters showed the first to be a full and splendid yellow, which was speedily followed by the usual green, and then, for a second and a half, by a full and perfect blue. Respecting the increased duration of the colour, I have found that when the atmosphere is sufficiently favourable to allow a power of sixty diameters being employed, with a 3-inch object-glass, the green effect is seen at that part of the sun's limb in contact with the horizon, even when one-half the sun is still unset, and of course from then till final disappearance.

The different colours seen, together with the order of their appearance, are suggestive of the prismatic action of the atmosphere as the cause of their production, and the interception of the horizon or the cloud as the cause of their separation.

Assuming the correctness of this view, it becomes evident that an artificial horizon would prove equally efficacious in separating the coloured bands, and also that if employed during an inspection of the sun's lower limb the least refrangible end of the spectrum would be disclosed. Accordingly I introduced into an eyepiece of my telescope a blackened disc of metallic copper, having a slit cut in it of about the one hundred and fiftieth of an inch in width, and proceeded to make an observation, in July, when the sun was about one-half of its meridian height. The blinding glare, however, of that portion of the sun seen through the slit rendered the observation futile. By projecting a large image of the sun into a darkened room, I was enabled to get the whole of the spectrum produced by the prismatic action of the atmosphere in a very satisfactory manner. In this case a semicircular diaphragm was used, so placed that its straight edge divided the field of view into equal parts, from one of which it obscured the light. The diaphragm was placed as before in the focus of the eyepiece, and by rotating it every portion of the sun's limb could be in turn examined, and that too in the centre of the field, so as to be equally subjected to the minimum of the peculiarities of the instrument. When the sun's lower limb was allowed to descend into the field of view the first rays were intensely red. After a momentary duration they gave place in succession to orange, yellow, and green, which were then lost in the ordinary refulgence of the sun. The upper limb gave green, blue, and finally purple, which latter colour I have thus far never seen upon the natural horizon. It should be remarked that the colours seen were vivid and unmistakable, and each one of them easily detained at will, or the whole phenomenon recalled, by the adjusting screws of the instrument. I apprehend that the results here given sufficiently prove that at mo-

spheric refraction is the cause of the coloured rays seen at the moment of the sun's departure below the horizon. I have, however, thought it worth while to examine the light proceeding from the moon's limb by the aid of the artificial horizon, and of course by direct observation. The results were decisive and satisfactory, the spectral colours being easily observed. The green effect I have also frequently seen on the departure of the moon beneath the edge of a dark and well-defined bank of clouds. Telescopic aid has, however, in every instance been required.

The rapid changes in colour observable in the case of almost any large fixed star at an elevation of twenty or thirty degrees above the horizon, and which changes vary between red, green, and blue, may I think be fairly attributed to the same cause as the colour in the sun's final ray. Particles of dust floating in the air ad, I apprehend, for the moment, in the capacity of diaphragm or horizon, and thus enable the eye to perceive, even in the light of the stars, the prismatic action of our atmosphere.

Ordinary Meeting, October 21st, 1873.

EDWARD SCHUNCK, Ph.D., F.R.S., F.C.S., Vice-President, in the Chair.

W. BOYD DAWKINS, F.R.S., exhibited a fragment of a post struck by lightning, on 2nd June, 1873. It formed one of three, about 8 feet high and 15 feet apart, in the garden of 11, Norma Road, Rushmore, and stood under a cherry tree, of which the stem was 10 feet away. It was completely shattered, fragments being driven as far as the walls of the house, 25 yards off, and the downward direction of the loose splinters implied that the explosive force was exerted from below upwards, instead of from above downwards. People in the Dickenson Road observed what they termed a "thunderbolt" fall, as they thought, on the house, and some of the inhabitants describe it as a flame of light followed immediately by a crash of thunder. It is very probable that the explosion was produced by an electric current passing from the earth upwards, and not vice versa.

Professor REYNOLDS attributed the shattering of the post to the explosive or repulsive action of an electrical discharge of unusual intensity.

Mr. BAXENDALL thought it was most probably due to the sudden conversion of a portion of the moisture in the post into steam of high tension by the heating action of the electrical discharge, and mentioned instances in which condensed vapour was said to have been seen rising from trees immediately after they had been struck by lightning.

"On the Relative Work spent in Friction in giving Rotation to Shot from Guns Rifled with an Increasing and a Uniform Twist," by OSBORNE REYNOLDS, M.A., Professor of Engineering, Owens College, Manchester, and Fellow of Queens' College, Cambridge.

The object of this paper is to show that the friction between the studs and the grooves necessary to give rotation to the shot consumes more work with an increasing than with a uniform twist; and that in the case of grooves which develop into parabolas, such as those used in the Woolwich guns, the waste from this cause is double what it would be if the twist was uniform. This is important, for, although the magnitude of this waste does not appear as yet to have been the subject of direct inquiry, it will be seen that with the plane grooves it amounts to more than 1 per cent of the whole energy of the shot, and, consequently, with the parabolic grooves it will amount to 2 per cent of the energy of the shot; that is, to say the least, important as regards the effect of the discharge; and when we consider that all the work spent in friction is spent in destroying the gun and the shot, we see that it becomes a matter of the very greatest importance whether the gun spends 1 or 2 per cent of its power on self-destruction.

MR. BAXENDALL read the following extract from a letter he had received from the President:—"You will see that

I have put a little drying apparatus to the short limb on my syphon barometer. I believe that a long open tube attached to the short end by a bit of india-rubber tube will do just as well. This I am going to try, and also to exclude the air more perfectly than I find it is in the instrument at the Rooms. The principal fear was that the sulphuric acid would slowly act on the mercury. I think the barometer has been put up long enough to decide this, and I feel convinced that the plan will succeed.

NOTICES OF BOOKS.

Chemistianity (Popular Knowledge of Chemistry); a Poem: also an Oratorical Verse on each known Chemical Element in the Universe, giving Description, Properties, Sources, Preparation, and Chief Uses, arranged for Familiar or Memory Reading. By J. CARRINGTON SELLARS, F.C.S. Published by the Author (at his Office), Ferry Buildings, Birkenhead.

THIS is, without exception, the most remarkable book of the season. Its title—water-marked on every leaf,—its style, its terminology, its probable design, must alike puzzle the unfortunate critic, who in addition, finds himself defied in such passages as the following:—

"Waste-paper set-trap writers shall daunt me not;
The greased feather of my good intents
Shall repel their assiduous scrip
As freezing water from Muscovy duck."

In place of the "Muscovy duck," we fear that a more familiar bird may possibly be suggested to the mind of the reader.

The work consists of a "proemium," treating of a promiscuous assemblage of topics; a "prologue"; a description of the elements in oratorical verse, forming the main body of the book; and an appendix, containing a proposal for an entirely new system of chemical nomenclature. Novel terminology is, indeed, the author's forte. Thus, where chemists would speak of "chemical action" or "reaction," the Chemistian uses the word "goception," derived, as he kindly informs us, "from 'gang,' to pass, and 'precipio,' to command." Then we have "floral" and "effloral" used as synonyms, respectively, for "mineral" and "organic." Copper is described as the "siamatic bond metal." Last, but not least, we instance "chemistianity" itself. Let us pause, however, before censuring the author for the use of such terms. If he has sinned, he is not alone. He may plead the example of men who, unable or unwilling to enrich science with new facts, new methods, or new generalisations, have earned fame, influence, and professorial chairs by the easier process of translating old doctrines into the terminology of the hour. If paradoxes and neologisms form the royal road to scientific eminence, it would be unfair to shut it against Mr. Sellars.

In the "proemium" the author exclaims:—

"Oh! would that the writers of systems
Themselves would write in some approved system,
Express their facts and views in aid and language,
With truth, similes, and impressiveness;
Then there would be less obscurity
And more learning, yielding hornpipe joys through Earth."

Let us make few selections to show the author's approved system:—

"Therefore a human being may be said to be on certain subjects—simple, knowledgeable, subearth-willed, high-witted or with godly lore endowed. One division of the condition of a moleculed being might (diffidently) be imagined as that of clarified godly lore."

Here is a portion of a Chemistian song:—

"Chemistian lore should be
Well known on land and sea
To sow the seed of chemistry,
So heigh, so ho, so hee.

Blart quacks will lose their say,
Labour have its due day,
Capital worked in equity,

So hee, so ho, so heigh.

Miss Basic Merit's foe,
Trade-fraud, we'll plunge in woe,
And urge Commercial Honesty,
So heigh, so hee, so ho."

We were not aware that Merit was "Basic" rather than acid, and that it, or rather she, was a young lady.

Elsewhere we read:—

"One toned word, like an old familiar tune,
Will suffice to canter a rhyming coon."

"Thus marl-past labour youth, with practical wit,
Tongue him with a Factor's queries and quips."

"By invention of cheap Aqua Blaster,
Which, started, will expensively gocept
When gocepted under Wheeler Blowdome."

From these and similar specimens, which might be greatly multiplied, we are forced to own that, however valuable the truths which the author seeks to convey, his mode of expression is not the most felicitous. It would be interesting to put this volume into the hands of some intelligent person totally unacquainted with chemistry, and to observe what notion of the science he would obtain from its perusal.

The "Oratorical Verse" contains little which is not correct in fact; still it would be difficult to find any information here which is not given more clearly and intelligibly in works easy of access. Hence we fail to see the *raison d'être* of the volume before us. Profit, we are bound to admit, cannot have been the author's motive for appearing in print. He may, possibly, be suffering from the effects of a certain book of which we have heard it said that, when the chemical student has done with it, he may hand it over to his sister or his sweetheart as a collection of crochet patterns.

Mr. Sellars concludes his work with a proposal for a system of "alphabetical composition names" for the chemical elements and "their mineral (floral) compounds." Hydrogen, for instance, is to be called "abgen," to be pronounced *abb*; water becomes DiAbbe; boric acid is TriAbAmtriBe; chloride of barium is diEbKke. Surely this proposal will commend itself to a certain section of the "Chemistian" world!

MISCELLANEOUS.

Iron in Tea.—Mr. Alfred Bird, of Worcester Street, sends a letter to the *Birmingham Daily Post* on this subject. He says—"In your report of yesterday's proceedings at the Police Court you make me say that 'the magnetic oxide was natural to tea.' What I said was 'that the magnetic oxide of iron exists naturally in the soil in which the tea plant grows,' in proof of which I stated that I had separated from the magnetic oxide of iron (found in the tea) particles of mica and quartz, the inference being 'that, as magnetic oxide of iron forms part of the soil of China, it would rise with the dust of the country, and, coming in contact with the damp leaves, would adhere to them when they are dried, and thus make the dried tea leaves stick to the magnet as if there were iron-filings mixed up amongst them.' I also stated that, not having any of the actual soil of China to examine for magnetic oxide of iron, it occurred to me to try if the dried leaves of plants grown in this country would be attracted by the magnet. Accordingly, I dried two grains of French bean leaves, grown in my own garden in the Bristol Road, and, to my great surprise, I found that particles of the leaves were attracted by the magnet, exactly like tea leaves. Now, as it was too absurd to suppose that the French bean leaves had iron-filings sticking to them, I carefully separated the broken leaves from the substance to which they adhered, and found that it was magnetic oxide of iron, the quantity in two grains of the bean leaves being 0.2 of a grain. The question then arose, 'Where did the magnetic oxide of iron come from?' To answer this, I dried a few ounces of the black mould of the garden, and, having separated it with the magnet, I attracted out abundance of the magnetic oxide of iron."

THE CHEMICAL NEWS.

Vol. XXVIII. No. 730.

PRELIMINARY INVESTIGATION OF THE FLUORESCENT AND ABSORPTIVE SPECTRA OF THE URANIUM SALTS.*

By HENRY MORTON, Ph.D.,
and H. CARRINGTON BOLTON, Ph.D.

(Continued from p. 246).

Uranic Phosphates.

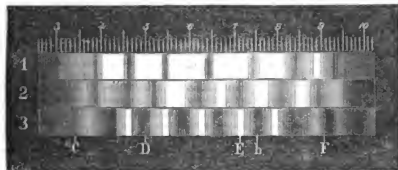
The salts of this class which we have examined are the following:—

Mono-uranic phosphate,	$U_2O_3 \cdot 2HOPO_3 + 3HO$
Di-uranic phosphate,	$2(U_2O_3) \cdot HOPO_3 + 3HO$
Di-uranic phosphate hexahydrate,	$2(U_2O_3) \cdot HOPO_3 + 6HO$
Di-uranic phosphate octohydrate,	$2(U_2O_3) \cdot HOPO_3 + 8HO$
Uranic pyrophosphate,	$2(U_2O_3)PO_4$
Calcio-uranic phosphate,	$CaO \cdot 2(U_2O_3)PO_3 + 8HO$
Cupro-uranic phosphate,	$CuO \cdot 2(U_2O_3)PO_3 + 8HO$

The phosphates, like the arseniates, show a remarkable fixity of spectrum, so that, with the exception of the first, all these compounds show the same spectrum of fluorescence. With regard to their absorptive action, a little more variation is manifested.

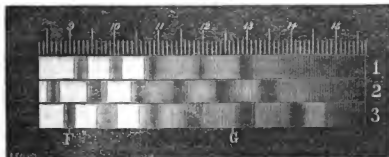
Mono-Uranic Phosphate. $U_2O_3 \cdot 2HOPO_3 + 3HO$.—This salt was formed by dissolving uranic hydrate in glacial phosphoric acid. The solution was evaporated in a desiccator until it attained a gelatinous consistency; in this

Fig. 15.



Phosphates.

Fig. 16.



Phosphates.

state it remained for weeks without crystallising. A portion was then transferred to a small specimen-bottle for examination, when it soon began to crystallise in an almost solid mass. Crystallisation also began in the larger quantity, where it had been disturbed, and soon (in a few days) pervaded it also. The material thus formed was

* Communicated by President Morton.

opaque, of a rich green colour, and very brilliant fluorescence. Its spectrum, shown at 1 of Fig. 15, consisted of very broad bands, leaving only narrow dark spaces between them. The material in its gelatinous state, and also the dilute solution, fluoresced, and gave a spectrum in which all the bands were displaced downwards in the spectrum, and are more rounded in character; this spectrum is shown at 2 of Fig. 15. The absorption spectra in these two cases are also well marked, and are given in Fig. 16—1 being that of the solid salt, and 2 of the solution. Both salt and solution held an excess of phosphoric acid.

The various di-uranic and double phosphates already named yield the same fluorescent spectrum, with no difference but a variation in brightness, and this spectrum is shown at 3 of Fig. 15. It so happened that the first specimen examined was one of di-uranic phosphate prepared in the usual way, which gave a double spectrum, as shown at 8 of Fig. 1. Of this, the upper and fainter series of bands corresponds with the above general di-uranic spectrum, while the other, which disappears on drying, no doubt belongs to some hydrate which we have as yet been unable to identify.

The absorption spectra of these salts present a considerable variety of forms. That of the mixed hydrates just mentioned is shown in 8 of Fig. 1, that of the calcio salt at 9 of the same figure, and that of the di-uranic phosphate at 3 of Fig. 16. We have obtained others, but have not yet determined the hydration of the specimens yielding them. It seems likely that these may afford a means of distinguishing some of these salts where their fluorescent spectra are identical.

Sulphates.

The general rule, that bases of the formula U_2O_3 require 3 equivalents of a monobasic acid to form neutral salts, is conspicuously violated by the element uranium, and it was this peculiarity in the constitution of uranium salts which prompted Peligot's assumption of the so-called uranyl theory: thus, neutral uranic sulphate has the composition $U_2O_3SO_3 + 3HO$, or, according to Peligot, $(U_2O_2)OSO_3 + 3HO$. This salt is easily obtained by acting on uranic nitrate with concentrated sulphuric acid, or by treating uranic oxide with strong sulphuric acid, and in either case expelling the excess of acid by raising the temperature to about 300° C. The mass is then dissolved in water, and the solution evaporated to the consistency of a syrup; after standing for some time, small lemon-yellow crystals form, which may easily be separated from the mother-liquid. As thus obtained, the salt, according to the best authorities, contains 3 equivalents of water, 2 molecules of which are driven off in a current of dry air at 100° C., but the third molecule is given up only on heating to about 300° C. In this anhydrous state, the great affinity of the sulphate for water is noticeable; each drop as it strikes the mass hisses, and is converted into steam. On dissolving the neutral salt in strong sulphuric acid, and crystallising by spontaneous evaporation, an acid salt, $U_2O_3SO_3 + HO_2SO_3$, is obtained. This uranic disulphate forms small needles grouped in warty concretions, and is of a much greener hue than the neutral sulphate. As will appear below, the spectrum of the salt is quite different from that of the neutral one.

A tri-sulphate is described by Berzelius, but its existence is denied by Peligot. Its formula, according to the uranyl theory, would be $(U_2O_2)O_3SO_3$, which is highly improbable. At present writing, attempts to obtain a tri-sulphate with a definite spectrum have been unsuccessful.

Ordway (*Am. Journ. Sci.*, [2], xxvi., 208, 1858) obtained a tribasic sulphate, $3\text{U}_2\text{O}_3 \cdot \text{SO}_3$, by treating a solution of the normal salt with baric carbonate; this compound, as well as the minerals johannite, zipperite, uranochalcite, medjidite, voghanite, and uraconite (Dana)—different varieties of hydrous uranic sulphate,—have not as yet been examined.

The optical study of the uranic sulphate was attended at the outset by great difficulties, arising from the fact that, after several specimens had been studied which gave the same spectrum—that, namely, shown at 1 of Fig. 17,—others, prepared under what were supposed to be identical conditions, showed such spectra as from previous experience we had reason to believe indicated the existence of a mixture (see 3, Fig. 17). After seeking in vain for any impurity, it became at last evident that these mixed spectra resulted from the presence of the salt in two states of hydration, which depended upon very slight variations in their mode of crystallisation and subsequent exposure. It

FIG. 17.

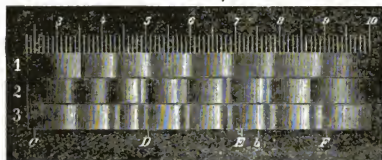
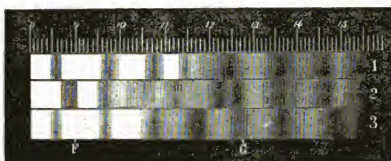


FIG. 18.



required, however, a long course of experiments to develop these facts, and to fix even some of these conditions, and others yet await further investigations.

To put the matter in its most concise shape, we will here briefly state the results so far obtained. When the uranic sulphate crystallises from a cold solution by evaporation in the air, or sometimes by cooling from a hot solution, it takes up 3 atoms of water, and yields the spectrum shown at 1, Fig. 17, which may be regarded as its normal spectrum. The presence of a moderate excess of acid does not seem to effect this, though it has a decided influence on the subsequent behaviour of the salt.

If this salt is exposed to the air until adherent moisture has been carried off, and is then slowly dried, at first below and then at 100°C , it will lose 2 atoms of water and pass to the condition of the mono-hydrated salt. It then yields such a spectrum as is shown at 2 of Fig. 17. If, however, the drying is carried on rapidly, as, for example, by placing the moist salt in a hot-water oven already at 100°C , evaporating the solution nearly to dryness on the water-bath, or occasionally even by drying over sulphuric acid, an amount of water is lost varying between 4.9 per cent and 5.7 per cent, and a double spectrum is developed, in which one set of bands seems to correspond with those of the mono-hydrate, and the

other set to be unlike those of the normal salt (see 3 of Fig. 17).

We have as yet been unable to isolate the substance giving these bands, but we have no doubt that they belong to the bihydrate of the uranic sulphate. By continuing to heat the substance in which this double spectrum has been developed we can reduce the strength of the bands belonging to this unisolated substance, and relatively strengthen those of the other, a small amount of water being at the same time expelled; but we cannot apparently reduce the mixture to the condition of the mono-hydrate alone. Thus a sample which had lost 5.7 by being heated suddenly to 100° , and refused to lose more at that temperature, by heating to 150°C lost 0.5 per cent more, and then maintained a constant weight. The spectrum in both cases being of the same duplex character, and differing only in the relative strength of the two sets of bands.

If this same salt in a normal state is placed suddenly in an oven at 150° it will lose about 8.7 per cent of water, but will again still show the same double spectrum, but with a loss of brilliancy in fluorescence. It therefore seems highly probable that in this case the salt has in part been reduced to an anhydrous condition in which it has no fluorescence.

The formation of certain of these hydrates seems to depend upon the combined action of heat and moisture due to the suddenness of the heat, which in driving out the water from part of the salt bathes another part in its hot vapour. We have made some experiments in the direction which this suggests, but as yet without reaching a decided result. There are, however, some analogous cases to which we would call attention. Thus the blue hydrate of cupric oxide changes to black anhydride by a heat of 100° when diffused in water; so the ferric hydrate. Again, a solution of $\text{ClO}_3\text{SO}_3 + 3\text{H}_2\text{O}$ yields, on heating, crystalline flakes of $2(\text{ClO}_3\text{SO}_3 + 3\text{H}_2\text{O})$, or abandons half its water. From what has been done, however, we think that we may, without risk of error, assume that the neutral uranic sulphate forms three hydrates with one, two, and three equivalents of water respectively, and that each of these has a distinct and characteristic spectrum.

The uranic disulphate gives a spectrum in which the bands are much less defined than are those of the normal salt, and are also less unlike in the abruptness with which they shade off on their upper and lower edges. The positions of their centres or brightest parts are given in the following table:—

Spectrum of Uranic Disulphate.

Bands.	1.	2.	3.	4.	5.	6.	7.	8.
	33.2	40.8	48.4	57.6	66.8	76.4	86.0	94.0

If this salt is dried over sulphuric acid it has its fluorescence somewhat reduced, and the position of its bands is elevated in the spectrum, as the following table will show:—

Spectrum of Dried Uranic Disulphate.

Bands.	1.	2.	3.	4.	5.	6.	7.	8.
	33.2	41.2	49.2	58.5	68.0	78.0	87.6	96.8

In solution the above-mentioned salts fluorescence with moderate brightness, and give banded spectra, the position of whose lines does not seem to differ from that of the solid salt. If a solution is made in strong sulphuric acid the fluorescence is very bright, but the position of the bands seems to be unchanged. In these solutions, however, the bands are in all cases less defined than in the solids.

The absorption bands of the neutral and acid sulphate are shown in 1 and 2 of Fig. 18 respectively, and in 3 we find the bands of the solution of either of these, or, indeed, of any other uranic sulphate which we have yet examined.

It would seem with the sulphates, as with the acetates, that all are reduced to the same condition when in solution, and that this condition seems to be that of the neutral acetate. There is, however, this decided want of parallelism in the two cases, that, whereas an excess of acetic acid is necessary to bring out the spectrum of the acetates, an excess of sulphuric acid seems to have no effect. The fluorescence, also, of these solutions is unaffected by an excess of acid, or, rather, is very much brighter where pure sulphuric acid is the solvent than in the aqueous solution.

(To be continued).

"IRON FILINGS" IN TEA.

By W. MATTIEU WILLIAMS, F.C.S.

I HAVE watched the progress of the tea controversy and the other public performances of the public analysts with considerable interest; it might have been with amusement, but for the melancholy degradation of chemical science which they involve. Among the absurdities and exaggerations which for some years past have been so industrially trumpeted forth by the pseudo-chemists who trade upon the adulteration panic and consequent demand for chemical certificates of purity, the continually repeated statements concerning the use of iron filings as a fraudulent adulterant of tea takes a prominent place.

I need scarcely remark that, in order to form such an adulterant, the quantity added must be sufficiently great to render its addition commercially profitable to an extent commensurate with the trouble involved. Now the gentlemen who, since the passing of the Adulteration Act, have by some kind of inspiration suddenly become full-blown chemists, have certified to wilful adulteration of tea with iron filings, and have obtained convictions on such certificates, when, according to their own statement, the quantity contained has not exceeded five per cent in the cheapest qualities of tea. Now the price of such tea to the Chinaman tea-grower, who is supposed to add these iron filings, is about fourpence to sixpence per pound; and we are asked to believe that he will fraudulently deteriorate the market value of his commodity for the sake of this additional 1-20th of weight. Supposing that he could obtain his iron filings at twopence per pound, his total gain would thus be about 1-10th of a penny per lb.

But can he obtain such iron filings in the quantity required at such a price? A little reflection or a few figures will render it evident that he cannot, and that such adulteration is utterly impossible.

I find, by reference to the *Gracer* of November 8th, that the total deliveries of tea in the Port of London during the first ten months of 1872 was 142,429,337 lbs., and during the corresponding period of 1873 139,092,409 lbs. Of this, about 84 millions of pounds in 1873, and 10 millions of pounds in 1872, were green, the rest black. This gives, in round numbers, about 160 millions of pounds of black tea per annum, of which above 140 millions come from China. As the Russians are greater tea drinkers than ourselves—the Americans and British colonists are at least equally addicted to the beverage, and other nations consume some quantity—the total exports from China may be safely estimated to reach 400 or 500 millions of pounds. Let us take the smaller figure, and, adopting the more moderate statements of the adulteration panic mongers, suppose that only one-fourth of this is adulterated, to the extent of 5 per cent, with iron filings. How much will be required? Just 5 millions of pounds per annum. Now it must be remembered the coarse filings could not possibly be used; they would show themselves at once to the naked eye as rusty lumps, and would shake down to the bottom of the chest; neither could borings, nor turnings, nor plane-shavings be used. Nothing but fine filings will answer the supposed purpose. I venture to assert that if the China tea-growers were to put the whole world under contribution for their supposed

supply of fine iron filings, this quantity could not be obtained. Let anyone who doubts this borrow a blacksmith's vice, a fine file, and a piece of soft-iron, then take off his coat and try how much labour will be required to produce a single ounce of filings, and also bear in mind that fine files are but very little used in the manufacture of iron. As the price of a commodity rises when the demand exceeds the supply, the Chinaman would have to pay far more for his adulterant than for the leaves to be adulterated. As Chinese tea-growers are not public analysts, we have no right to suppose that they would perpetrate any such foolishness.

The investigations recently made by Mr. Alfred Bird, of Birmingham, show that the iron found in tea leaves is not in the metallic state, but in the condition of oxide, and he confirms the conclusions of Zöller, quoted by Mr. J. A. Wanklyn in the *CHEMICAL NEWS*, of October 10, viz., that compounds of iron naturally exist in genuine tea.

It appears, however, that the ash of many samples of black tea contains more iron than naturally belongs to the plant, and accepting Mr. Bird's statement that this exists in the leaf as oxide mixed with small siliceous and micaceous particles, I think we may find a reasonable explanation of its presence without adopting the puerile theory of the adulteration maniac, who in his endeavour to prove that everybody who buys or sells anything is a swindler has at once assumed the impossible addition of iron filings as a make-weight.

In the first place we must remember that the commodity in demand is black tea, and that ordinary leaves dried in an ordinary manner are not black but brown. Tea leaves, however, contain a large quantity of tannin, a portion of which is, when heated in the leaves, readily convertible into gallo-tannic or tannic acid. Thus a sample of tea rich in iron would, when heated in the drying process, become by the combination of this tannic acid with the iron it contains, much darker than ordinary leaves or than other teas grown upon less ferruginous soils, and containing less iron.

This being the case, and a commercial demand for black tea having become established, the tea grower would naturally seek to improve the colour of his tea, especially of those samples naturally poor in iron, and a ready mode of doing this is offered by stirring in among the leaves while drying a small additional dose of oxide of iron, if he can find an oxide in such a form that it will spread over the surface of the leaf as a thin film. Now it happens that the Chinaman has lying under his feet an abundance of material admirably adapted for this purpose, viz., red hæmatite, some varieties of which are as soft and unctuous as graphite, and will spread over his tea leaves exactly in the manner required. The micaceous and siliceous particles found by Mr. Bird are just what should be found in addition to oxide of iron, if such hæmatite were used.

The film of oxide thus easily applied and subjected to the action of the exuding and decomposing extractive matter of the heated leaves would form the desired black dye or "facing."

The knotty question of whether this is or is not an adulteration is one that I leave to lawyers to decide, or for those debating societies that discuss such interesting questions as whether an umbrella is an article of dress. If it is an adulteration, and as already admitted, is not at all injurious to health, then all other operations of dyeing are also adulterations, for the other dyes, like the Chinaman, add certain impurities to the silk, wool, or cotton, in order to alter their natural appearance, and give them the false facing which their customers demand, but with this difference, if I am right in the above explanation, that in darkening tea nothing more is done but to increase the proportion of one of its natural ingredients, and to intensify its natural colour, while in the dyeing of silk, cotton, or wool, ingredients are added which are quite foreign and unnatural, and the natural colour of the substance is altogether falsified.

ON THE
ACTION OF BROMINE ON THE WATER-SALTS
OF SUCCINIC, MALIC, MALEIC, AND
PYRO-CITRIC ACIDS,

CRITICALLY EXAMINED AND INTERPRETED FROM THE
STANDPOINT OF THE "TYPO-NUCLEUS" THEORY.

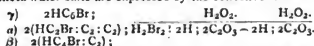
By OTTO RICHTER, Ph.D.

(Concluded from p. 251).

PART II.

On the Principal Molecular Changes that attend the Action
of Bromine on the Water-Salts of Pyro-Citric Acid.

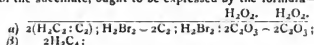
When the three isomeric modifications of pyro-citrate of water are treated with bromine, the resulting dibrominated water-salts are expressed by the collective formula—



In this process the bromine is understood to act in accordance with the second method, so that the first stage will be marked by the direct union of 2 mols. of bromine with the complex carbon adjunct.

In the next stage 2 mols. of water suffer decomposition, their oxygen serving to oxidise the formous acid principal, while their hydrogen, by reading upon the dibrominated carbon adjunct, gives rise to a molecule of hydrobromic acid, which, by transposing with the colligated alcohol, completes the formation of the new compound.

The reader, by taking his cue from the behaviour of the ortho-succinate under similar circumstances, will not be slow to perceive that the dibrominated derivative of the ortho-pyro-tartrate, which is the next upper homologue of the succinate, ought to be expressed by the formula—



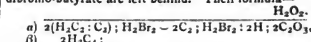
but although Lagermann and others have tried to obtain this compound by the usual method, they do not seem to have arrived at satisfactory results.

In connection with this subject a singular fact has been brought to light, which is, that under the influence of sodium amalgam these three varieties of meta-dibromo-pyro-tartrate agree with their parent molecules, the three varieties of pyro-citrate, in producing but a single variety of ortho-pyro-tartrate, instead of the three which are indicated by theory.

In order to account for this discrepancy, I proceed upon the hypothesis that the three varieties of meta-pyro-tartrate are actually formed at the commencement, but that in the existing conditions they are speedily made to merge into the β variety of the ortho-pyro-tartrate.

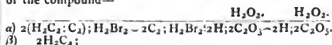
It is meet that I should now advert to a very interesting series of transformations which certain descendants of the three varieties of meta-dibromo-pyro-tartrate are apt to

experience under the influence of certain chemical reagents. When the salts of these three varieties are boiled with water, carbonic acid is given off, and two varieties of dibromo-butyrate are left behind. Their formula—

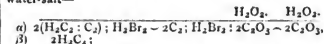


is based upon the following train of reasoning:—

In the first stage, 2 mols. of water yield up their oxygen to the formic acid ally; while their hydrogen, by reading upon the bromo-hydrocarbon adjunct, gives rise to a molecule of hydrobromic acid, whose immediate union with a molecule of formen, &c., completes the formation of the compound—



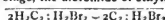
This meta water-salt soon resolves itself, in the next stage, into 2 mols. of water which are liberated, and the ortho water-salt—



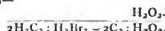
which, by the loss of 2 mols. of carbonic acid, becomes finally converted into the dibromo-butyrate, as formulated above.

It is at this point that the interesting series of metamorphoses commences, to which allusion has just been made, but for the proper comprehension of which I require to submit first of all the analysis of a kindred and more familiar, but as yet perfectly unintelligible, series of reactions. The case selected for illustration and comparison refers to the characteristic deportment of the dibromide of ethylene on its being subjected to the alternate influence of hydrate of potash and bromine. Now the molecular changes attending the successive stages of this curious reaction may be described as follows:—

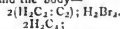
In the first stage, the dibromide of ethylene—



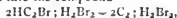
transposes with the hydrate of potash, with production of the compound—



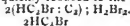
and bromide of potassium, under the influence of which the former molecule is speedily made to resolve itself into 2 mols. of water and the body—



In contact with 2 mols. of bromine, this latter becomes then changed into the compound—

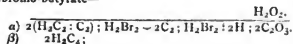


which, with the aid of a second molecule of hydrate of potash, becomes quickly reduced to the body—

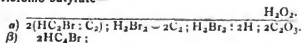


SYNOPTICAL ARRANGEMENT OF CHEMICAL FORMULAE, COMPRISING THE BROMINATED DERIVATIVES OBTAINED BY THE
ALTERNATE ACTION OF HYDRATE OF POTASH AND BROMINE ON THE DIBROMO-BUTYRATE OF WATER.

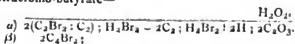
Dibromo-butyrate—



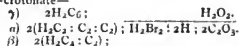
Tribromo-butyrate—



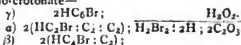
Tetrabromo-butyrate—



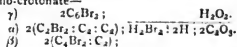
Bromo-crotonate—



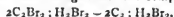
Dibromo-crotonate—



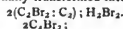
Tribromo-crotonate—



In contact with a second pair of bromine molecules, this latter becomes then changed into the compound—



which, with the aid of a third molecule of hydrate of potash becomes finally transformed into the body—



By applying the preceding train of reasoning to the dibromide of allylen, which in the dibromo-butyrate is made to play the part of a halogen adjunct, the reader will not find it difficult to interpret the molecular changes which ensue on the dibromo-butyrate being subjected to a similar treatment. It will, therefore, suffice to append a list of the chief transition products with which, in the absence of the customary winding up, this paper is perhaps rather abruptly brought to a close.

ANALYSIS OF CIGAR ASH (HAVANNAH).

By A. PERCY SMITH, F.C.S.

Potash sulphate	7'401
Potash carbonate	9'012
Soda chloride	3'272
Soda carbonate	1'039
Calcium sulphate	4'180
Calcium carbonate	45'400
Ferric oxide and phosphate	0'460
Calcium and magnesia phosphates	9'210
Silica	9'641
Carbon	3'162
Traces of alumina and lithia carbonate, and loss, &c.	1'459

100'000

PROCEEDINGS OF SOCIETIES.

GLASGOW PHILOSOPHICAL SOCIETY.

(CHEMICAL SECTION).

THE first meeting of the session of the Chemical Section of the Philosophical Society of Glasgow was held on the evening of Monday, November 10th, when Dr. William Wallace, F.R.S.E., delivered the opening address as retiring President.

After a few introductory remarks, Dr. Wallace spoke with some detail on the operation of the Adulteration A₂, and the difficulties attending it so that convictions might be obtained in accordance with its spirit. He specially referred to milk and tea among the articles of food that are subjected to adulteration. The only cure for the anomaly of retailers of tea being subjected to the hardship of being severely fined for selling adulterated tea, though they were perfectly innocent of the fact that it was adulterated, would be to have each cargo of tea, as it arrives at port, examined by Government officials, who should have power to order the destruction of all tea which had been mixed with adventitious matter. Dr. Wallace considered that there could be no doubt that the Adulteration A₂ would greatly increase the number of professional chemists in this country. Already some of the gentlemen appointed as Analysts had exercised their vocation, not only in testing the samples submitted to them, but also in adding important facts to our knowledge regarding certain articles of food. He strongly urged the desirability of appointing, as Analysts under the A₂, competent and experienced chemists having reputations to support, and making it worth their while to give attention to their duties, by giving them fixed incomes in addition to moderate fees.

The prevention of smoke next received some notice from Dr. Wallace, and the operation of the law relating to that subject was shown to be somewhat anomalous in Glasgow, inasmuch as a person might erect a hundred puddling furnaces within the city, which might give off dense volumes of the blackest smoke day and night, without the owner being interfered with, for the law could not touch him; but if the thousandth part of the smoke were emitted from a badly-fixed boiler, the myriads of the law would pounce upon the owner at once.

Dr. Wallace dwelt at considerable length upon the chemical questions involved in the disposal of the sewage of large towns, and the conservation of the purity of rivers. There was probably no great town or city in the three kingdoms where the whole question of the disposal of the sewage had been so thoroughly discussed, or so perfectly understood, as in Glasgow, and there was perhaps none in which so little had been done. The local sewage literature was of great extent and value, but the citizens had hitherto been content to look on and witness the experiments conducted elsewhere, sometimes at enormous expense, and the failures that had almost invariably attended the experiments. There were local gentlemen, high in office, who were in favour of the great Bateman and Bazalgette scheme of pumping and conveying the Glasgow sewage to the sands on the Ayrshire coast, for the purpose of irrigation, at a cost of something like £2,000,000; but he sincerely hoped that those gentlemen would study the subject further, and see for themselves the results of sewage irrigation elsewhere. For the Glasgow sewage an area of 25,000 acres, or nearly forty square miles, would be required for the Glasgow sewage if irrigation were to be resorted to.

After speaking of the various systems of sewage filtration and so-called purification—General Scott's, the A B C, and that by the use of peat charcoal, as practised at Bradford—Dr. Wallace said that a revised Pollution of Rivers A₂ would doubtless be passed next session, and that not unlikely it would be made applicable to Scotland as well as to England, in which manufacturers would be brought under a very stringent law; but, as long as the water-closet sewage was discharged into rivers, it would be ridiculous to impose penalties upon manufacturers for adding their comparatively trifling contribution of polluting ingredients. Dr. Wallace concluded his address by making some very practical remarks regarding the endowment of scientific research, a subject to which renewed interest had been imparted by the address of Professor Williamson as President of the British Association at its recent meeting at Bradford. He said it was disgraceful that in Glasgow, a city which owed so much of her wealth to chemical manufactures, there was no professor of technology, and that even the chair of chemistry was so miserably endowed that its occupant—one of the ablest and most industrious of modern chemists—was obliged to eke out the means of subsistence by commercial work which, though important enough in itself, might be performed equally well by men of far inferior talent and originality.

Speaking of analytical work, he said that, in this country especially, it had become an important branch of the profession, and that it had of late years attained a scientific precision which it never before possessed. It was not uncommon for analyses to be made for commercial purposes, and for a comparatively trifling fee, with greater skill and a higher degree of accuracy than was exhibited in a large proportion of the researches published in scientific journals; and it often happened that a chemist brought up in what might be called a strictly scientific laboratory was totally incapable of undertaking the simplest analyses with results that were of any practical use. Such knowledge, like every other kind that was valuable, was only to be acquired by hard work and great practice, but that fact made it impossible for an analyst having a large and engrossing business to devote any portion of his time or talents to the higher branches of chemical study. Other sub-divisions of chemical science led to the

same exclusiveness of thought and narrowing of observation it was just to prevent the evil results that would naturally follow that a Society such as the Chemical Section was valuable in bringing together men who studied different branches of the science, and enabled them to communicate their ideas and knowledge to the mutual benefit of all.

The address was listened to most attentively and heartily applauded, and at its conclusion, on the motion of Mr. Mayer, seconded by Mr. John Jex Lang, a cordial vote of thanks was passed to Dr. Wallace. A hope was also expressed that the address would as soon as possible be published *in extenso* in the *Proceedings* of the Philosophical Society.

CORRESPONDENCE.

PUBLIC ANALYSTS.

To the Editor of the *Chemical News*.

SIR,—Every chemist will be pleased with your remarks upon the way in which the Adulteration of Food &c is being carried into law. I think that it is high time that something be done to stop the sliding of the post of public analyst into unqualified hands. So far as the appointments of analysts have as yet proceeded, they have either fallen upon one lucky individual, or relapsed into the possession of a complete tyro. It is stated that Professor Gardner, of the Polytechnic, is unable to "qualitatively" detect alum in bread for a fee of 10s. 6d., but he can do so "quantitatively" for 5 guineas. I allude to the Shore-ditch case. Will "the learned Professor" kindly explain? He has given his share towards the impression that there ought to be a "Society for the Protection of Tradesmen from Analysts."—I am, &c.,

Os.

[We shall probably give an article in our next issue on the detection of alum in bread.—Ed. C. N.]

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopaedic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the *CHEMICAL NEWS*, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, Octobre 13, 1873.

Purifier for Coal-Gas, Capable of Serving at the Same Time for Mixing Gases with the Vapours of Liquids.—M. D. Colladon.—Gas requires to be freed from particles of solid matter, naphthalin, coal-tar, ammoniacal salts &c., as well as from gases such as carbonic and sulphurous acids. For washing it vessels have been employed similar to Woolf's bottle, in which the gas traverses water or a suitable solution through a metallic network in the form of bubbles or continuous currents. This arrangement is insufficient for working on a large scale; because the bubbles of gas take a spherical form, and consequently present a minimum of surface for a maximum volume. Further, this method requires a decided increase of pressure, which is inconvenient. Chemical "cascades," in which the gas passes upwards through a fine rain of the washing liquid, act much better,

but require too large a quantity of liquid. Coke-towers (scrubbers) produce a more complete effect, but the action is irregular. The new mechanical washing apparatus has the advantage of producing very powerful action without requiring large dimensions. At Geneva it yields coal-gas, superior both in illuminating power, and in a sanitary point of view. Less purifying matter is also required than on the old system. The same apparatus will doubtless prove useful when it is required to saturate a gas with the vapours of a liquid, e.g., hydrogen with the vapour of petroleum. The system rests on this principle, that the best arrangement either for washing a gas or for saturating it consists in making it strike, in the form of currents as thin as possible, against solid walls kept perpetually moist. The currents are broken against these surfaces, and are prevented from moving on in a straight line. The gaseous particles are thus always kept in a rotatory movement, and are pressed against the moist walls, so that they may either absorb the substance diffused over these walls or may deposit there a part of their own substance, according as it is required to saturate the gas or to wash it.

New Method of Tempering Steel, and Regeneration of Burnt Iron.—M. H. Caron.—A piece of steel is generally tempered, and then re-heated more or less according to the hardness and the elasticity which it requires to receive. The dry temper, as commonly practised, that is to say, the plunging the red-hot metal into cold water, has the drawback of developing cracks and crevices injurious to its tenacity. Re-heating does not remove these flaws; and subsequently on use these fissures, though invisible at first, increase and terminate in fractures. It has already been discovered that in order to escape from this danger it is preferable to temper the steel a little less hard, and afterwards to re-heat more slightly. The author has succeeded in producing the combined effects of tempering and re-heating in one operation, and of removing as far as possible the chances of flaws. This is done by heating the water into which the red-hot metal is plunged to 55°. Tempering in hot, or even boiling water, modifies soft steel containing two- to four-thousandths of carbon. This process augments its tenacity and elasticity without sensibly altering its softness. The texture is changed and becomes fibrous, even if previously crystalline. The author's method for restoring burnt metal is likewise to plunge it at a red heat into a hot liquid.

Use of Bisulphate of Potassa as Test for Galena in all its Mixtures.—M. E. Jannetaz.—It is sufficient to throw upon coarsely pounded galena a fragment of bisulphate of potash to produce a distinct evolution of sulphuretted hydrogen. If the two bodies are ground together the odour becomes almost insupportable. Bisulphate of potash, kept in fusion for half-an-hour, produces the same effect, perhaps with less intensity. Sulphuric acid, mixed or even heated with galena, does not give rise to a sensible disengagement of sulphuretted hydrogen. Blende gives a sulphidic odour, but less intense. Sulphides of antimony, iron, mercury, and silver give off no sensible odour. Boulangerite, zinkenite, bournonite, and, in general, the sulphides in which lead and sulphur do not form an isolated combination, do not yield their sulphur to the bisulphate of potassa.

On Crystalline Dissociation (Continued): Evaluation and Distribution of Work in Saline Solutions.—MM. Favre and Valson.—The authors here examine the coercitive effects produced by some thirty different salts on their solvents. The following are some of the chief results:—(1) All the salts examined, except chloride, bromide, and iodide of ammonium, give contraction. (2) Taking as measure of coercitive action the specific contraction represented by—

$$\frac{V-v}{V}$$

(where V is the volume of an equivalent of the salt

and the increase of volume in the water) the salts, with regard to coercive energy, may be thus grouped; first group, carbonates and borates; second, sulphates and fluorides; third, chlorides, acetates, and bromides; fourth, iodides. Comparing the metallic radicals we have this other arrangement:—first, aluminium and copper; second, strontium, barium, and calcium; third, sodium and potassium; fourth, ammonium. Sulphate of alumina and carbonate of soda gave the greatest contraction; iodide of ammonium gave the least. (3) In dissolving there are two opposite effects—contraction of the solvent and increase of volume of the salt; the former being generally greater than the latter. (4) The values of d (the densities of "normal" solutions in which an equivalent of the salt is dissolved in 1 litre of water) afford new evidence that each saline radical produces in the solution an increase of density, which is proper to it, and independent of, any other radical with which it may be associated. (5) The negative values of $V-v$ obtained for chloride, bromide, and iodide of ammonium, and the almost nil value of $V-v$ for nitrate of ammonium, seem to show that in salt solutions the ammoniacal salts are in a much more advanced state of dissociation than the other salts studied. The authors next offer some observations which seem to favour the supposition that the constituent elements of salts themselves may experience, in a certain measure, a phenomenon of dissociation more or less advanced, such as occurs, e.g., in the passage of ordinary hydrogen to the state of active hydrogen. We may interpret the phenomenon of coercion by comparing with it the well-known phenomenon of the condensation of gases and liquids by solid bodies. Consider what occurs when CO_2 (for example) is condensed by charcoal. The gas, in condensing to the full, liberates a quantity of heat greater than that which it liberates in solidifying. Moreover, in condensing by successive fractions, the first fraction of gas liberates more heat than the second, the second more than the third, and so on to the last. So that, under the coercive influence of charcoal, the carbonic acid seems to form layers of decreasing density (starting from the surface of condensation). Something very similar probably occurs when a salt is in the presence of water; the molecular surfaces of the solid, brought to a state of extreme division, acting on the water, and giving it a density superior to that which it has in the liquid state, and even in the solid state.

Researches on the Ancient Fauna of the Island of Rodrigues.—M. Alph. Milne-Edwards.—This island, about three hundred miles E.N.E. from Mauritius, had in the 17th century a rich vegetation and varied fauna; but the animals have almost entirely disappeared, in consequence, direct or indirect, of the destruction of the woods by burning.

Verification of Huyghens's Law of Double Refraction by the Prism Method.—Extrait from memoir by M. Abria.—Suppose a bi-refracting surface in the form of a prism presenting five dihedral angles; the axis having a certain direction. If one measures for a particular line, D for example, the index of refraction of each of the rays, bringing the prism into the position of minimum of deviation for the rays, one should find a constant value of the index for one of them, which will be the ordinary ray, and will thus be determined. The prism being in the position of minimum deviation, for the ordinary image, if one measures the angle which the emergent rays form, ordinary and extraordinary, in their exit from the prism; this may then be compared with the result obtained by Huyghens's law. If there is agreement no doubt can remain as to the correctness of this law. The author gives, in a table, the result of eighteen experiments; ten with a prism of spar, and eight with two quartz prisms. The differences are nearly always under $\frac{1}{100}$ th of the quantity measured, thus confirming the law.

Researches on the Action of Substances Termed Antiseptic on Carbonaceous Virus.—M. Davaine.—

(It was stated in a previous note that the virus was destroyed by a temperature varying between 48° and 55°C ., according to the duration of application of the heat.) The antiseptic agents examined are arranged in the following order of power:—Ammonia, silicate of soda, ordinary vinegar and phenic acid, caustic potash, chloride of oxide of sodium, hydrochloric acid, permanganate of potash, chromic acid, sulphuric acid, iodine. The power of ammonia, vinegar, and phenic acid being represented by 1, that of iodine will be represented by 11800.

Studies on Phylloxera. (Continued).—M. Max Cornu.—The insect attacking the leaves is the same as that attacking the roots, but it is less attracted by the former.

Reproduction of Phylloxera of the Oak.—M. Balbiani.—The reproduction of the apterous generations of phylloxera in summer is by parthenogenesis; but this is not the only way of reproduction of the insect.

Meteorological Observations in a Ballon.—M. Tissandier.—The ascent took place on the 4th ult. about midday, from the gas-works of La Villette. A lower current carried the aërostat in the direction E.S.E., but at a height of 700 metres there was a south-west current which carried it to the N.E. The lower had a velocity of 6 to 7 kilometres in the hour, the higher 35 kilometres. The maximum height reached was 2600 metres, where the balloon entered an extensive bank of cumulus. The polarisation of the atmosphere was here much weaker than at the surface of the ground. The hygrometric and thermometric measurements are given. The shadow of the balloon was always visible on the ground. At 1.35 p.m., and at a height of 700 metres, this shadow—projected on a meadow—appeared to be surrounded by a very bright aureole of yellow colour.

New Remarks on the Epidemic Goitre in the Barracks at St. Etienne.—M. Bergeret.

Revue Hebdomadaire de Chimie Scientifique et Industrielle, par Ch. Mène, No. 41, 1873.

Vinous Syrups for the Fabrication of Low Class Wines.—These syrups are special saccharine liquids analogous to the juice of grapes, containing tannin, salts, &c., and colouring matters. It appears that they are to be mixed with the residue of the grapes after the first pressure and pressed again, so as to yield a further quantity of a liquid which may pass for wine. M. Mène thinks that by this system "dangerous and gross falsifications" may be prevented; which are a calamity to the country and to society, because they interfere with and injure not merely health, but (what M. Mène appears to think more important) "business and progress."

Destruction of the Phylloxera and other Parasites of the Vine.—Tessié du Motay waters the vine at its roots with a solution of a soluble alkaline or alkaline hyposulphite. When this solution is judged to have penetrated sufficiently, he waters anew with a solution containing a sufficient quantity of acid phosphate of lime, soda, or potash so that the excess of phosphoric acid may saturate the base of the hyposulphite, and liberate sulphur in the nascent state. In another procedure the same chemist recommends to water with an alkaline or alkaline-earth polysulphide, and subsequently with a sufficient quantity of an alkaline bisulphite to produce the same reaction, the liberation of nascent sulphur.

Bulletin de la Société d'Enregistrement pour l'Industrie Nationale, No. 251, November, 1873.

Distribution of Potash and Soda in Plants.—M. Eug. Peligot.—This paper is taken from the *Comptes Rendus*, and has been already noticed in our columns.

Boettger's Portable Ink.—The author saturates several sheets of paper with aniline-black, and presses them together into a compact and portable mass. For

writing it is merely necessary to tear off a piece of this paper, and steep it in a little water.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, Tome xxxii., No. 10, November 6, 1873.

New Fuel.—Pagliari has invented a new combustible to take the place of coal. It consists of—

Distilled petroleum	20 kilos.
Resin	30 "
Coal dust	40 "
Charcoal dust	30 "
Saw dust	6 "
Sulphate of lime	10 "

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The petroleum is placed in a metal boiler heated by steam, the temperature being gradually raised to 75°. It is constantly stirred, and when the resin is dissolved the steam is shut off, and the other substances are introduced. When the whole is thoroughly incorporated it is run into moulds. Clay may be substituted for the coal. In another formula 25 parts of crude petroleum are substituted for the 20 parts of distilled petroleum. It is announced that the calorific power of this combustible is double or even triple that of coal. (We doubt whether a mixture containing nearly one-fourth its weight of resin, can ever seriously compete with coal even at present prices.)

Revue Scientifique de la France et de l'Etranger,
November 1 and 8, 1873.

These numbers contain no chemical matter.

Gazzetta Chimica Italiana, Anno iii.,
Fascicolo ix., 1873.

Action of Cyanide of Potassium on Bichloroacetic Acid.—D. Amato.—In a former notice the author speaks of a substance of a finely crystalline appearance. Its composition is—

Carbon	.. ..	41.5
Hydrogen	.. ..	5.7
Nitrogen	.. ..	16.0
Oxygen	.. ..	36.8

100.0

and its formula $C_6H_{10}N_2O_4$. The author treats likewise on the action of cyanide of potassium upon dilute alcohol, and on a new method of preparing aliphatic ether.

New Reagent for Iodates.—Egidio Pollacci.—The proposed reagent is very sensitive, and can be applied as well in cases where the iodates are unmixed as where they are associated with iodides. If phosphorus is placed in contact with an aqueous solution of iodate of potassium the iodine of such salt, however dilute may be the solution, is perfectly reduced. The same reaction occurs with other iodates. The first action is a partial reduction of the iodate, with formation of phosphoric acid and iodide of potassium. Subsequently the phosphoric acid acts upon the iodide as well as upon the iodate, forming phosphate of potash, and iodic and hydriodic acids. Lastly, these two acids being incompatible form water and iodine.

Bulletin de la Société Chimique de Paris, tome xx., Nos. 6 and 7, October 5, 1873.

Reciprocal Action of Oxalic Acid and of the Polyatomic Alcohols; Application to the Manufacture of Formic Acid.—M. Lorin.—The author has previously pointed out the principal phenomena resulting from the reciprocal action of oxalic acid and glycerin. He finds that the same acid gives identical results with ordinary glycol, octylic glycol, erythrite, mannite, dulcitol, and

quercitol. From the first addition of an equivalent of common oxalic acid, the formic acid is almost entirely fixed upon the equivalent of polyatomic alcohol. The physical properties of the alcohol exert an influence upon the stability of the oxalic acid. Water has also an influence contributing to the regular etherification of the oxalic acid and to the constancy of the limit. For the preparation of formic acid, 1.120 kilos. of pure glycerin and 3 kilos. of powdered oxalic acid were placed in a roomy retort. The reaction was kept up by making successive additions of the acid, morning and night, in such quantities that the original level of the mixture was kept up. The retort was cooled a little before each addition. 65.25 kilos. of oxalic acid yielded 42.14 kilos. of formic acid at 54.6 per cent = 23.004 kilos. of pure acid.

Hydrochlorate of Tereben, and on the Isomerism of the Compounds of the Formula $C_{10}H_{16}HCl$.—M. J. Ribau.—The hydrochlorate of tereben consists of—

Carbon	.. ..	69.8
Hydrogen	.. ..	9.85
Chlorine	.. ..	20.57

100.00

It fuses at 125°, and is rapidly decomposed in contact with water.

Solubility of Sulphate of Lead in Acetates.—H. C. Debbits.—The author finds that sulphate of lead is soluble in the acetates of soda, lime, manganese, zinc, nickel, and copper. The acetates of mercury and silver have no such solvent action. The acetate of baryta, at common temperatures, partially converts the sulphate of lead into acetate of lead and sulphate of baryta; the inverse reaction does not take place.

Certain New Sulpho-Salts.—R. Schneider.—The author has examined the sulpho-palladiate of potash and sulpho-palladiate of silver; tetra-platinum sulpho-stannate and tetra-platinum sulpho-platinate.

Artificial Production of Crystalline Fluor-Spar and Sulphate of Baryta.—Th. Scheerer and E. Drechsel.—Fluor-spar has been obtained in octohedral crystals by fusing the amorphous fluoride in the chlorides of calcium, potassium, or sodium, and cooling slowly. The authors have also obtained the fluoride of barium in crystals on evaporating its solution in dilute nitric acid.

Sulphate of Ethylen Diamin.—M. von Lang.—This compound, belonging to the tetragonal system, exhibits the phenomena of circular polarisation. Its crystals have the forms p, a_1, b_1 , &c. The ratio of the axes = 0.6692 : 1. These crystals, without exhibiting hemihedrism, polarise some to the left and others to the right. The solutions appear inactive. It is isomorphous with the sulphate of platino-diammonium, $SO_4(PtN_2H_{12})$, the crystals of which have been recently determined by Topsoe. Ratio of the axes = 0.6899 : 1. These crystals do not display circular polarisation.

Action of Sulphydrate of Potassium on the Aromatic Nitriles.—A. Weddige.—The author has caused this body in alcoholic solution to act upon pure cyanide of benzyl. The result was α -toluic amide, $C_6H_5 \cdot CH_2 \cdot CONH_2$.

Preparation of the Bromides of Quinine, Morphia, and Strychnia.—G. Macdonald.—The author prepares these bromides by exactly decomposing the sulphates by the bromide of barium, and evaporating the filtered liquid. The hydrobromate of quinine forms silky crystals, apparently anhydrous and soluble in 4 parts of cold water.

Reactions of Apomorphia.—MM. Quehl and Kehler.—Apomorphia gives with sulphocyanide of potassium a white curdy precipitate, soluble in heat. With the yellow ferrocyanide, the solution becomes reddish and opalescent, and deposits fine flocks, which separate more quickly if heated, agglutinate, and turn green. The red (ferri-) cyanide gives a curdy precipitate, which turns violet on heating. Tannin gives a greenish yellow precipitate, which

does not dissolve on heating. With chloride of gold, there is formed a bulky purple precipitate. With picric acid, there appears, even in very dilute solutions, a lemon-yellow precipitate soluble on heating. Sulphate of copper gives a bluish turbidity, which turns green on heating. Iodide of potassium gives a blood-red precipitate, which disappears on heating. Stannous chloride produces a white precipitate, soluble on heating.

Researches on Curarin.—A. Flückiger.—With oxidising agents in presence of sulphuric acid, curarin gives the same violet coloration as strychnia, but the purity of the shade is injured by a brown accompanying body. If a saturated solution of bichromate is added to extract of curare, preferably prepared with dilute glycerin, uncrystallisable chromate of curarin is precipitated, whilst that of atrychin crystallises readily. Chromate of curarin dissolves in sulphuric acid with an intense, but transient, blue, while the chromate of strychnia becomes violet.

New Researches on the Coagulation of Fibrin.—A. Schmidt.—To precipitate completely the fibrino-plastic material from serum, four drops of acetic acid should be added to 10 c.c. of ox-blood diluted with 15 volumes of water, and free from globules. All substances which decompose oxygenated water seem by their mere contact to promote the coagulation of fibrin.

Quick Bleaching.—The goods are plunged in a bath containing 2.5 to 3.3 kilos. of chloride of lime per hectolitre of water. After six to twelve hours, it is washed, and boiled two to four hours in a bath of carbonate of soda, containing 650 grms. of soda per hectolitre. If the fibre is very hard it is plunged, before boiling in the soda bath, into an acid bath containing 3 kilos. of sulphuric acid per 100 litres, and allowed to drain before boiling. It is then washed, and put in a bath, hot or cold, of 2.5 to 3.3 kilos. of chloride of lime, and 700 grms. of soda per hectolitre, and washed after four to six hours.

Use of Bisulphide of Carbon in Cleansing Wool.—M. Jean.—The sulphide of carbon does not injure wool in the cold, and removes the grease readily. Its removal by means of a current of cold air is tedious, and involves considerable waste. If steam or hot air be employed, the wool loses its softness and elasticity, and takes a permanent yellow tone; benzol is therefore far preferable.

Reimann's Färber Zeitung, No. 39, 1873.

This number contains a receipt for a safflower-rose on glazed calico. The dressing consists of 50 lbs. of wheat-starch, 20 lbs. of wheat-flour, 4 lbs. of white wax, and 6 lbs. of cocoa-nut oil, a little sulphuric acid being added to the water in which the starch is mixed.

There are also receipts for a light and a deep prussian blue on glazed calico; for a green (extracts of indigo and of quercitron) on jaconnets; a peach-wood crimson on glazed calico and jaconnet; a brown on calico with Bismarck brown and magenta; a grey drab on wool; and a scarlet on woollen cloth and flannel; also, a blue (soluble aniline blue) and a coffee-brown on plush; a violet on woollen yarn. The mordant in this case consists of 1½ ozs. of tannic acid dissolved in hot water in which 4 ozs. of Marseilles soap is next dissolved; 4 ozs. of rape oil is next added, and stirred up till it forms an emulsion. The liquid is used at 60° F. The bleached yarn is worked in this mordant for fifteen minutes, and then withdrawn. The colour-bath, at the same temperature, is prepared with 5 ozs. of alum and the clear solution of 1 oz. of methyl violet.

There is also a prescription for a light green on cotton yarn, the colour being methyl green fixed with tannic acid.

The editor gives a receipt for a brown on shoddy, containing a mixture of cotton, called on the Continent "velour." To 100 lbs. of this material, make up a bath of 30 lbs. of fustic, 3 lbs. of alum, 2 lbs. of prepared tartar, and 1 lb. of blue vitriol, in which the shoddy is boiled for

half an hour. To the same lot are then added 1 lb. of chromate of potash and 1 lb. of "aniline red," "ruby," or "aniline crimson," known on the Continent as "rosain." The dyeing is carried on at a gentle boil, and turmeric added to modify the shade. Logwood may be used, if needful, to darken. Aniline red is a refuse magenta; it is dissolved in hydrochloric acid, and boiled in water previous to use.

Test for Chrome Yellow and Orange.—M. Duvalier.—The author proposes to test these colours for sulphate of lead by heating 1 part of the colour with 3 parts of nitric acid at 1420, 2 parts of distilled water, and 1 part of alcohol. The chromic acid set at liberty oxidises the alcohol. The mixture is heated till nitrous fumes are no longer given off. The remaining liquid contains nitrate of lead and chromic oxide, and a white precipitate of nitrate of lead, mixed with sulphate if any be present. The whole is mixed with water, and boiled, when sulphate of lead alone remains. A much simpler process is to treat the sample with potash ley, when the colour dissolves and sulphate of lead remains. The possible presence of the sulphates of strontia and baryta has been overlooked by the author, upon whom Dr. Reimann passes some very severe strictures.

Protarator for Woollen Dyeing.—10 kilos. of alum dissolved in 40 litres of hot water; 3.5 kilos. of oxalic acid, dissolved in 20 litres of hot water, and 2 kilos. of acetic acid. As compared with tartar, this mixture is said to effect a saving of 50 per cent.

No. 40, 1873.

This number contains receipts for a catechu brown on glazed calico; an iron buff on stout cotton goods; for a deep olive green and a drab on wool; a coal-black, a blue-black, and a deep corinth on plush; also, a black on cotton yarn, capable of bearing milling; and a blue on shoddy, the cotton in which has been first destroyed by the vapour of hydrochloric acid, and the residue neutralised with chalk. In dyeing, a preparation is used, known as "shoddy-carmine." It is made by dissolving in two pails of hot water—12 lbs. of alum, 9 lbs. of indigo-carmine, and 3 lbs. of soluble aniline blue.

Preparation of the Hair of Rabbits for the Manufacture of Felt Hats.—These hairs were formerly treated with a solution of mercury in nitric acid, for the purpose of enhancing their felting properties. A mixture of nitric acid and treacle is proposed as a substitute.

No. 41, 1873.

This number contains receipts for an iron-grey on silk; a "naturel" on stout cottons and on gauze; for greys on a variety of materials; for a black on half-wool clothes; for a medium brown, a yellow-brown, and a dark and light brown on plush; a white on wool, blue slightly with alkali-blue R, or methyl-violet BBBB; a violet-brown colour for printing on cotton yarns (warp printing); and a flavin-yellow on calico.

Archiv der Pharmacie, July, 1873.

Sugar Found in Grass Roots; and on Triticin, a New Carbohydrate from the Roots of Triticum repens.—(Conclusion).—H. Müller.

Oleate of Mercury with Oleate of Morphia.—Ch. Rice.

Cheap Disinfectant.—E. C. C. Stanford.

Action of Dilute Saline Solutions on Lead.—M. P. Muir.

Colouration of Chloral Hydrate with Oil of Peppermint.—C. Jehn.

Tests for Crocosote and Phenol.—J. A. Flückiger.

THE CHEMICAL NEWS.

VOL. XXVIII. No. 731.

ALUM IN BREAD.

It is unfortunate that proceedings under the Adulteration Act should have been taken in the matter of the so-called adulteration of flour and bread with alum. In the first place, it is highly probable that this so-called Adulteration is a meritorious Act, and that the inventor of it deserves a civic crown, as would be due to him who should increase the harvest every year. Alum is added to flour and bread in order that flour, which otherwise would not make good bread, may be enabled to do so. By treatment with a trace of alum, flour of doubtful soundness is endowed with soundness. For this purpose a proportion of alum is required which does not exceed 20 grains to a 4-lb. loaf.

One of the most important functions of the public analyst is to withstand popular clamour and to oppose professional prejudice—prejudice which owes its origin to imperfect acquaintance with the matter in hand. And this case is an illustration in point. The 20 grains of alum have been sensationally dealt with; and the people, and professional persons who ought to know better, have attributed tanning of the stomach and ruin of the digestion to these 20 grains of alum in the 4 lb. loaf.

Nothing is easier than to show the unreasonableness of such notions; and perhaps some of those persons who are suffering from them will be surprised to be told that the phosphate of potash in a 4-lb. loaf (and which existed in the flour of which the 4-lb. loaf is made) is far more than enough to transform the alumina contained in the 20 grains of alum into phosphate of alumina.

It is useful to call to mind that of the 20 grains of alum about half is water, and that there are only about 2.2 grains of real alumina (Al_2O_3) in 20 grains of alum.

Under these circumstances, we are almost tempted to rejoice in the difficulties which beset the public analyst in his attempts to detect traces of alum in bread. We are not surprised that the public analyst returns bread which has been purposely alumed as being devoid of alum, inasmuch as the detection of traces of alum in presence of the constituents of the ash of bread is one of the most difficult problems of chemical analysis.

In connection with this subject the following remarks on the detection of alum in bread, published by the Editor of this journal some years ago, may not be inappropriate at the present time:—

"This problem is one of far more difficulty than is generally imagined, and it is doubtless to this fact that the discordant results obtained by different analysts are to be attributed: one stating that out of sixty-four samples of bread purchased at various shops in poor neighbourhoods at the East of London, where, if anywhere, adulteration would be practised in the most barefaced manner, not a single one was found to contain alum; whilst another analyst, with equal positiveness, mentions the name of a baker who is, in his opinion, almost the only person in a large district at the West End of London who sells unadulterated bread, and proceeds to state that more than

87 per cent of the bread in London is adulterated. Very few of those who have published anything on this subject give details respecting the process they adopt, but in most instances it seems to be somewhat to the following effect:—The bread is first charred and burnt nearly to an ash; the latter is then boiled in diluted hydrochloric acid, with which a little nitric acid has been mixed; ammonia is then added, and the precipitate which it produces is boiled in potassa. After filtration, hydrochloric acid is to be added in excess, and then ammonia, when it is supposed that the precipitate will consist of alumina. With a pure solution of alumina to start with, doubtless this process would give accurate results; but it must be remembered that in bread the alumina would be accompanied by phosphoric acid, as well as phosphate of lime and phosphate of magnesia, each of which would make its appearance in the last precipitate with ammonia, and would consequently pass for alumina. But, granting that this tendency of the phosphates of lime and magnesia to simulate the reactions of alumina had been provided against, it seems to have been almost entirely overlooked by popular writers on this subject that whenever alumina and phosphoric acid meet together in solution, they adhere with the greatest pertinacity, and will infallibly appear together in the last precipitation. I should not have deemed these points worthy of mention did I not know that many analysts are habitually employing similar processes to the above, and are even estimating quantitatively the amount of adulteration in bread by weighing this precipitate of the mixed phosphates of lime, magnesia, and alumina, and calculating it as pure alumina.

"My attention was first drawn to this subject by the fact that a sample of bread which was known to be entirely free from adulteration had been pronounced by a somewhat experienced analyst as being largely adulterated with alum. My assistance was asked in order to disprove this injurious allegation, and, having accordingly submitted the subject to a somewhat lengthened examination, I am induced to lay the results before the readers of the *CHEMICAL NEWS*, in the hope that, when the attention of chemists is drawn to the subject, it may be investigated as fully as its commercial importance deserves.

"The great difficulty in my hands has been to devise a process which should not confound other things with alumina. It was easy to frame various modes of operating by which a minute trace of alumina could be detected, but I was for a long time baffled by finding that they were equally delicate in their reactions, whether alumina were present or not. In fact, I do not hesitate to say that the accurate analysis of a mixture of those phosphates which are precipitated from an acid solution by ammonia is one of the most difficult problems in inorganic chemistry that the chemist is liable to meet with in technical analysis. I do not pretend to have yet solved the difficulty, but the process which I have at last adopted has at least the merit of not showing the presence of alumina when that body is absent. It has, on the other hand, the inconvenience of being rather tedious in its manipulation, and to some may seem to be needlessly complicated. No one can be sensible of this fact more than myself; but of the numerous methods which I have tried, both with and without separating the phosphoric acid, this was the only one which invariably gave me trustworthy results.

"The bread, of which at least 500 grains should be taken, is first to be incinerated in a platinum or porcelain dish, until all volatile organic matter has been expelled and a black carbonaceous ash remains. The temperature must not be raised much beyond the point necessary to effect this. Powder the coal thus obtained and add about thirty drops of oil of vitriol, and heat until vapours begin to rise; when sufficiently cool, add water and boil for ten minutes. Filter and evaporate the filtrate until the fumes of sulphuric acid begin to be evolved, when ten grains of metallic tin and an excess of nitric acid must be added, together with water, drop by drop, until action between the acid and metal commences. When all the tin is

oxidised, add water and filter. Evaporate the filtrate until fumes of sulphuric acid are again visible, when more water must be added, and the liquid again filtered if necessary. To the clear solution now add tartaric acid, then ammonia in excess and sulphide of ammonium. Evaporate the liquid, containing the precipitate suspended in it, in a dish, until all the smell of sulphide of ammonium has disappeared. Filter, evaporate to dryness, and ignite to get rid of the organic matter. Powder the black ash, boil it in moderately strong hydrochloric acid, filter, add a crystal of chlorate of potash, and boil for a minute. Now add chloride of ammonium and ammonia, and boil for five minutes. If, at the end of that time, any precipitate is observed it will be alumina. From the filtered solution, if oxalate of ammonia be added, the lime will be precipitated; and if to the filtrate from this, ammonia and phosphate of soda be added, the magnesia will come down."

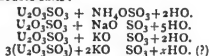
PRELIMINARY INVESTIGATION OF THE FLUORESCENT AND ABSORPTIVE SPECTRA OF THE URANIUM SALTS.*

By HENRY MORTON, Ph.D.,
and H. CARRINGTON BOLTON Ph.D.

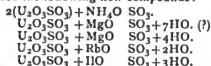
(Continued from p. 259).

Double Sulphates.

Uranic sulphate has heretofore been known to form the following double salts:—



The last-named was obtained by Berzelius, but Ebelmen and Péligot could not reproduce it. To this list we have added the following new compounds:—



The history of the ammonio-diuranic sulphate has been already given in a previous part of this paper, and we need only add here that we have as yet been unable to prepare it otherwise than by the decomposition of the

When solutions of equivalent weights of uranic sulphate and rubidium sulphate are brought together, and the proper degree of concentration has been reached, warty concretions of minute crystals form, possessing a hue of remarkable beauty and a brilliant fluorescence. So strong is this that the white porcelain dish in which the crystals form appears pink by contrast.

Thallio-uranic sulphate forms in a precisely similar manner, but is of a golden yellow colour with a fine lustre, but very slight fluorescence. It is not readily soluble in water, but is very stable, being easily re-crystallised from hot solution. Analysis of these salts has not been completed in time for insertion in this preliminary notice.

We will now pass to the optical study of these salts in their alphabetical order.

Ammonio-Uranic Sulphate, $\text{U}_2\text{O}_5\text{SO}_3 + \text{NH}_4\text{OSO}_3 + 2\text{H}_2\text{O}$.

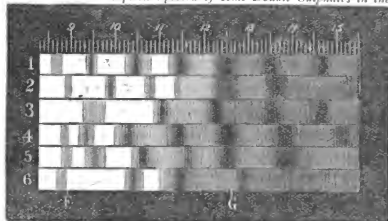
—The spectrum of this salt has been already described, but for completeness we will here reproduce it with some additional data. The bands of this substance are distinguished by great abruptness on their more refrangible side, rising as it were suddenly to a narrow brilliant line, and then fading off gradually on the lower side in a manner suggesting a rounded convex surface. Their positions are shown in 1 of Fig. 20.

In the first experiments made with this salt it was heated to about 200°C . to drive off its water, but subsequent experience showed that the same result might be reached by a continued application of a temperature of 200°C . Two atoms of water in this salt would amount to 6.71 per cent; and it was found that a specimen bottle placed in a hot-water oven continued to lose weight for about twelve hours. At the end of this time its total loss was 7 per cent, and its weight then remained constant, even when it was heated to about 250°C . Its fluorescent spectrum was then that shown at 3 of Fig. 20. Its characteristic was a new position of the bands, and a much more rounded and less brilliant appearance. This salt does not appear to form any mono-hydrate, and in fact presents a great contrast to the uranic sulphate and sodio-uranic sulphate as regards the fixity of its two forms, the normal or bihydrate and anhydrous state. The position of its absorption-bands has been already shown at 10 of Fig. 1, and will also be seen at 1 of Fig. 19.

Ammonio-Diuranic Sulphate, $2(\text{U}_2\text{O}_5\text{SO}_3) + \text{NH}_4\text{OSO}_3$.

—This salt, which, as we have before stated, is obtained by heating the dried ammonio-uranic sulphate in an open vessel to a temperature of about 325°C ., or, in other words, a heat competent to fuse lead in the same vessel, and which will then bear a temperature little short of redness

FIG. 19.
Absorption Spectra of some Double Sulphates in the Solid Form.



Ammonio-uranic sulphate.
Ammonio-diuranic sulphate.
Magnesio-uranic sulphate.
Rubidio-uranic sulphate.
Sodio-uranic sulphate.
Thallio-uranic sulphate.

ammonio-sulphate as there described. Both the magnesium salts were formed under conditions seemingly identical, when a cold solution of the mixed sulphates was allowed to concentrate over sulphuric acid.

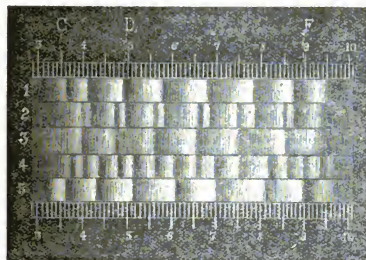
* Communicated by President Morton.

without further decomposition, yields a spectrum such as is represented in 5 of Fig. 20, and whose bands are as bright and sharply defined on the upper edge as those of the hydrated ammonio-sulphate; from which they are to be distinguished only by their position, and perhaps by their greater breadth descending more gradually into the

dark spaces on the lower side. The bands near 70 and 80 of the cut are not correctly shown, the first being too low, and the second too high. They should show an even spacing, one having its upper edge at 70.5 and the other at 80. The absorption spectrum of this salt is shown at 2 of Fig. 19.

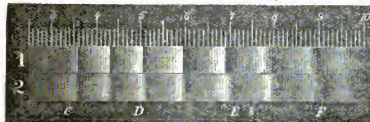
Magnesium-Uranic Sulphate.—As we have already noticed, a mixture of uranic and magnesian sulphates will form two compounds, one of these, which seems easy to reproduce, having the formula $U_2O_3SO_3 + MgOSO_3 + 4HO$. The other

FIG. 20.



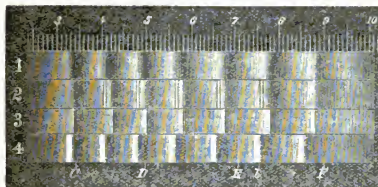
Ammonio-Uranic Sulphates.

FIG. 21.



Potassio-Uranic Sulphate.

FIG. 22.



Sodio-Uranic Sulphates.

we have only succeeded in obtaining once in small quantity. This and the fact that it was then mixed with magnesium sulphate, render an accurate analysis impossible, but a determination of the water and sulphuric acid seems to indicate that the body has the formula $U_2O_3SO_3 + MgOSO_3 + 7HO$. We would, however, only present this as a suggestion. The two salts yield fluorescent spectra, which are entirely distinct in the positions of their bands, although both are alike, and of what we have called the normal form in their general character. The following table will show this

relation; A being the normal salt, and B that which we can only name by a conjecture:—

Fluorescent Spectra of Magnesian-Uranic Sulphates.

Bands.	1.	2.	3.	4.	5.	6.	7.	8.
A ..	—	40.4	48.0	55.5	65.7	74.6	84.8	91.6
B ..	—	44.8	53.0	66.4	70.8	81.0	90.5	96.0

The measures here given are of the upper edges of bands; except the 8th, which is measured at its centre. The absorption spectrum of the normal salt, A, is given at 3 of Fig. 22, and is characterised by the absence of the lower bands found in other double sulphates.

Potassio-Uranic Sulphate, $U_2O_3SO_3 + KO_3SO_3 + 2HO$.—This salt readily crystallises out when a solution of the mixed sulphates in atomic proportions is allowed to evaporate in the air; it forms warty concretions of minute crystals of a yellow-green colour and very bright fluorescence. In this state it contains 2 atoms of water, and shows the spectrum represented in 1 of Fig. 24, which is of the normal character, with a sharp termination of each band on its upper edge, and the bands peculiarly broad and bright.

This salt suffers no change by heating or drying at 100° C., but if dried at 150° C. it loses all its water, and its spectrum changes to that shown at 2 of Fig. 21, in which the bands are much rounded, and displaced a little upward in the spectrum. It would thus appear that this salt can exist, and display fluorescent action as a bihydrate and anhydrate, but we have obtained no evidence of its forming a monohydrate.

The absorption spectrum of the hydrated salt will be seen at 1 of Fig. 19, being indistinguishable from that of the ammonio-salt. The spectrum of the anhydrate is more difficult to observe, but by using the substance in powder with a little oil between slips of glass we can make out bands whose centres are at 93.7, 101.0, 111.7, and 124.4 respectively, and which are therefore quite unlike those of the normal salt.

Rubidio-Uranic Sulphate, $U_2O_3SO_3 + RbOSO_3 + 2HO$.—The preparation of this salt we have already described, and we will therefore pass at once to its fluorescent spectrum. In this the bands are much blended or rounded, and are decidedly lower than the corresponding ones of the potassium salt. Their brightest parts are located as follows:—

Fluorescent Spectra of Rubidio-Uranic Sulphate.

	1.	2.	3.	4.	5.	6.	7.	8.
	34.0	41.6	49.2	57.6	66.7	76.0	85.2	94.8

This substance loses 2 atoms of water if it is dried at 100° C., but its fluorescent spectrum is not changed as regards the position of its bands; the brightness of its fluorescence is, however, reduced. An exposure to a yet higher temperature (180° C.) causes a slight loss of weight (0.6 of 1 per cent), and yet further reduces its fluorescence without other effect. The absorption spectrum of the normal salt will be found at 4 of Fig. 19.

Sodio-Uranic Sulphate, $U_2O_3SO_3 + NaOSO_3 + 5HO$.—This salt presented more difficulties at the outset than any other, and, as might be expected, has yielded some very curious results. Thus a certain specimen was observed to yield the peculiar spectrum shown at 2 of Fig. 22, while the rest of the crop of crystals in another bottle from which it had been taken showed nothing of the sort. A prolonged study of this body has evolved the following facts, and has shown that many more await further investigation:—This salt in its normal state, containing 5 atoms of combined

water yields the spectrum shown at 1 of Fig. 19, which is of the normal type. A portion of this water is, however, lost with great ease, occasioning the formation, under ordinary conditions, of mixtures of several hydrates. Some of these we have been unable to isolate and determine, but we have found that, by gradually drying at a temperature of $150^{\circ}\text{C}.$, we obtain a monohydrate whose spectrum is that shown at 3 of Fig. 19. If the salt in a damp state is placed suddenly in the oven at $150^{\circ}\text{C}.$, it will lose almost all its water, and give a spectrum sensibly continuous; in this condition it may be dried at $200^{\circ}\text{C}.$ without suffering any change. When heated to 250° to 290° the salt loses all its water, and then acquires a spectrum such as is shown at 4 of Fig. 19, in which each band looks like a prismatic column. Under various conditions, which we have not yet been able to determine with certainty, intermediate amounts of water are lost, and mixtures of other hydrates are produced, in which, no doubt, salts with 2, 3, or 4 atoms of water are involved. These, once formed, will, like the corresponding hydrates of uranic sulphate, maintain themselves in the presence of desiccating treatment, which would deprive the normal salt of much more water. The absorption spectrum of the normal salt is shown at 5 of Fig. 19. It is, perhaps, unnecessary to state that the peculiar spectrum shown at 2 of Fig. 22 is believed to be produced by three or more overlapping spectra belonging to as many mingled hydrates.

Thallio-Uranic Sulphate, $\text{U}_2\text{O}_5\text{SO}_3 + \text{TiO}_2\text{SO}_3 + 3\text{H}_2\text{O}$.—This substance has a very faint fluorescence. Bands can be made out at $62.4(\text{?})$, 35.6 , and 76.0 ; below the first of these three seems to be a faint continuous spectrum. This salt loses $3\text{H}_2\text{O}$ and all its fluorescence by drying at $100^{\circ}\text{C}.$ Its absorption spectrum is shown at 6 of Fig. 19.

NOTES OF WORK BY STUDENTS OF PRACTICAL CHEMISTRY IN THE LABORATORY OF THE UNIVERSITY OF VIRGINIA.

(No. II.)

Communicated by J. W. MALLET,
Professor of General and Applied Chemistry in the University.

- (1). *On the Best Mode of Converting Calcium Oxalate into Carbonate in the course of Analytical Work.* By Mr. J. R. McD. IRBY, of New Orleans, Louisiana.

CALCIUM precipitated as oxalate is sometimes weighed as such after drying at $100^{\circ}\text{C}.$, is sometimes converted into carbonate by heating to a carefully regulated temperature just short of redness, sometimes converted into lime by heating to bright redness or beyond, and sometimes given the form of sulphate by treatment with sulphuric acid or ammonium sulphate.

Of these four modes of procedure, although accurate results can be obtained by any one of them,* the second is, on several grounds, to be preferred for general use.

If the oxalate itself be weighed, an unburnt filter, previously tared when dried at $100^{\circ}\text{C}.$, has to be weighed with it, and the errors which may be allowed to arise from hygroscopic moisture affecting this filter at either of its weighings, and the tube or watch-glasses used to contain it are more likely to influence the result to a serious extent than those from similar causes when but the ash of a filter and a small crucible are concerned.

The conversion into caustic lime requires a very strong heat, generally obtained by means of a blast lamp, the blowing being kept up for some time. The last traces of carbon dioxide are driven off with difficulty, and the platinum crucible is liable to alter slightly in weight, while the risk of mechanical loss from the blast, and the great readiness with which moisture is taken up from the

atmosphere by the lime during cooling and weighing, are not to be altogether overlooked.

The acid fumes given off during the conversion into sulphate and final evaporation are annoying, and the heating is tedious and requires very careful watching to prevent loss.

Pure calcium carbonate is undoubtedly the most stable and desirable form in which to obtain the final product for weighing, and if at once obtained by carefully managed heating of the oxalate, as may be accomplished in well-trained hands,* leaves nothing to be desired; but if the temperature be allowed to rise a little too high, and a little caustic lime be formed, the necessary evaporation with solution of ammonium carbonate is tedious and troublesome, and cannot be hastened without almost certain loss from spitting. Moreover, while a very small quantity of lime can thus easily be restored to the condition of carbonate, if any considerable amount of material have to be dealt with the moistening and evaporation will often need to be repeated more than once before the weight becomes constant. The object in heating is, therefore, to so regulate the temperature as to ensure the complete destruction of all oxalate, and to avoid altogether the decomposition of the carbonate. The statement of the writers on analytical chemistry, that the proper temperature is represented by very low redness, or should be just short of redness, is wanting in precision. Working at night or in the daytime, by bright sunlight or on a dark, cloudy afternoon, one's estimates of barely visible redness will represent by no means a small range of temperature, and it needs a good deal of personal supervision to teach a new laboratory student exactly how to proceed, so as to obtain at once, without the delays above referred to, a result so often called for as an accurate determination of calcium.

In order to simplify and give greater precision to the details of the process, it was suggested to Mr. Irby to get some better measure of the temperature really required, and to find, if possible, some empirical rule for its ready production and regulation.

Not having at command one of Siemens's electric resistance pyrometers, it was attempted to estimate the temperature needed for the decomposition of the oxalate by comparison with the melting-points of some of the metals.

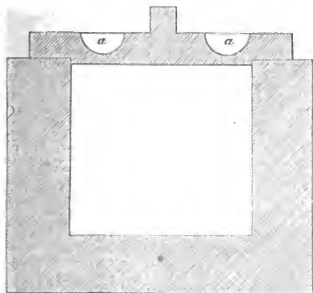
Calcium oxalate (specially prepared and found to be quite pure, and fully dried at $100^{\circ}\text{C}.$) heated to the melting-point of lead for a short time, was found, on cooling, to have begun to decompose, but the extent of the change was quite small. At just the melting-point of zinc the weight could easily be reduced to within one or two per cent of the theoretical amount, but several hours' exposure to this temperature scarcely produced complete reduction to carbonate. Several metallic alloys were tried, in order to get from some one of them a barely-fused bath of the proper temperature, but they all gave too much trouble from surface oxidation and the tendency to separate into a more and a less fusible portion. Finally, it being ascertained that a heat but very little beyond the melting-point of pure zinc was required, the following arrangement was found practically successful.

A solid cylinder of cast-iron, smoothly turned, 53 mm. high and 66 mm. in diameter, has a cylindrical hole of 40 mm. deep and 40 mm. diam., drilled into the upper end, thus producing a sort of crucible with walls and bottom 13 mm. thick. A turned disc of cast-iron, 58 mm. in diameter and 6.5 mm. thick, with a little knob in the middle of the upper surface to serve as a handle, formed a cover; and in the upper surface of this cover, two hemispherical cavities, each 10 mm. in diameter, were drilled at opposite sides, the centre of each 15 mm. distant from the edge. Round the outside of the cylinder a little groove was turned, which enabled the whole to be supported over a lamp by a stout iron wire triangle.

* See paper by Aug. Souchay in Fresenius's *Zeitschr. f. Anal. Chem.* 10 Jahrg., 3 heft., s. 323, and remarks upon same by Fresenius in same periodical, s. 326.

* Fresenius, in his excellent "Anleitung zur Quant. Chem. Anal.", 5 Aufl., s. 201, has given minute directions as to the details.

The figure shows this thick walled crucible and cover in vertical section. The total weight was about 1050 grms. In the little cavities (*a a*) bits of metallic zinc of about a gramme each were placed, a piece of porcelain, such as a small crucible cover, was placed in the bottom of the cast-iron vessel, and upon this a platinum or porcelain crucible (the latter being found to answer best, on account of its inferior conducting power) containing the calcium oxalate to be heated. Gas from a Bunsen burner with tube of 9 m.m. diameter was used as the source of heat, and the position of the burner was so regulated that, when the stopcock was fully opened, the flame played



over the bottom of the cast-iron block and about one-fourth up the outside all round. With quantities of 1 to 1.5 gm. of oxalate, the full flame of the lamp was turned on at once, the mass of iron in the block ensuring sufficiently gradual heating, and it was then only necessary to notice when the bits of zinc in the cavities of the iron cover had fully melted; the decomposition was then complete. This took about thirty minutes, but during that time no attention on the part of the operator was needed. The calcium carbonate left in the crucible was quite free from caustic lime. The following are two examples of the results:—

Calcium oxalate taken.	Calcium carbonate obtained.	Calcium carbonate calculated.	Lime (derived from oxalate) as calculated from carbonate.	Lime calcu- lated directly from oxalate.
Grm.	Grm.	Grm.	Per cent.	
1.0388	0.7109	0.7115	38.32	38.36
1.5765	1.0792	1.0798	38.33	„

It proved to be important that the decomposition of the greater portion of the oxalate should take place without the carbon monoxide gas given off taking fire, since the additional heat produced by its combustion through and on the mass sufficed to burn a little of the carbonate into lime, and the tendency to separation of carbon (rendering the mass dark in colour) was much greater when the gas took fire, while carbon once separated could not be well burnt off again without increasing the heat too much. The effect of too rapid heating, attended with the burning off of carbon monoxide, is shown by the following results, obtained in experiments in which the maximum temperature derived from the lamp was no higher than in others of entirely satisfactory character:—

Percentage of Lime obtained from Oxalate.		
Found.	Calculated.	
38.18	38.36	
38.19		

Hence, when the oxalate amounted to about 2 grms., it was found better to turn on the gas to the lamp somewhat

gradually and to keep up the heat longer, about three quarters of an hour being required, while, for quantities of 3 grms., an hour was necessary.

In the course of actual analysis, the oxalate being upon a filter, as much as possible of the substance should be detached from the paper and treated as above described, while the filter itself is burnt upon the lid of the platinum or porcelain crucible, the minute residue left treated with one or two drops only of strong solution of ammonium carbonate, which small quantity can be dried up quite quickly and easily on a water-bath or gently heated sand-bath, and the cover then introduced into the cast-iron cylinder along with the crucible; the two to be taken out, cooled, and weighed together.

- (2). *Analysis of Atacamite from Australia.* By Mr. J. A. CABELL, of Richmond, Virginia.

In Dana's "Mineralogy," 5th edition, p. 121, the formula assigned to atacamite is—

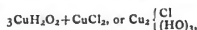


(old atomic weights of copper and oxygen), or 3 molecules of cupric oxide, 1 of cupric chloride, and 4 of water, the author remarking that one or two analyses give one-half more water. Rammelsberg ("Handb. d. Mineralchem.," s. 191) makes three varieties of the mineral, each containing 3 molecules of cupric oxide and 1 of the chloride, but therewith 3, 4, and 6 molecules of water respectively.

In view of this discrepancy of results as to the amount of water, and there seeming to be no recorded analysis of Australian atacamite, a portion of a very fine, well-crystallised specimen, of rich dark green colour, from South Australia, was placed in the hands of Mr. Cabell for analysis. Sp. gr. of mineral = 4.314. The following were the results, neglecting traces of insoluble siliceous residue, ferric oxide, and alumina:—

	Found.	Calculated.
Cupric oxide	56.64	55.85
Copper	14.67	14.87
Chlorine	16.44	16.63
Water	12.02	12.65
	99.77	100.00

The figures in the last column are calculated from the formula—



which probably represents the composition of normal atacamite, while the larger proportions of water found in some of the recorded analyses may perhaps be due to alteration.

The water was determined directly by Mr. Cabell, and the facts carefully established that it had all been driven off and that no chlorine had been volatilised.

I myself obtained some years ago, from a specimen of clean, sandy atacamite from Chili (Rammelsberg, "Handw. d. Ch. Th. d. Mineral.," 5 suppl., s. 57).

Cupric oxide	55.94
Copper	14.54
Chlorine	16.33
Water	12.96
Quartz	0.08
	99.85

numbers agreeing well with the above results.

- (3). *Analysis of Burnonite.* By Mr. C. E. WATT, of Little Rock, Arkansas.

Choice fragments of beautifully crystallised burnonite, from Herodasfoot Mine, near Liskeard, in Cornwall, of sp. gr. 5.826, gave, on analysis—

Sulphur	19'359
Arsenic	0'469
Antimony	23'577
Lead	41'949
Copper	13'268
Iron	0'679

99'301

leading to the recognised formula for the species—



the only noteworthy point being the replacement of a little of the antimony by arsenic. This does not seem to have been before observed for bournonite, although so common in other minerals containing the sulphides of these metals. The perfectly crystallised condition of the specimen examined negatives the idea of an admixture with tetrahedrite.

- (4). *Analysis of an Iron Slag of Fine Blue Colour from Barrow Iron Works, Lancashire (England).* By Mr. J. R. McD. IRBY.

This slag was very compact, tenacious, and hard—declared by a lapidary to be fully equal in hardness to the most refractory jasper; fracture splintery and imperfectly conchoidal. Its colour was a remarkably fine blue, quite comparable with the darker varieties of *lapis lazuli*, so that a specimen cut *en cabochon* made a handsome stone for a finger ring. Sp. gr. = 2'883. When reduced to an impalpable powder, it was completely decomposed by strong hydrochloric acid, with loss of colour, evolution of hydrogen sulphide, and separation of flocculent silica. It was ascertained that none of the sulphur present existed in oxidised form. Analysis gave—

Quotients on dividing by Molecular Weights.		
Silica	46'683	0'778
Alumina	5'769	0'056
Ferrous oxide ..	1'208	0'008
Manganous oxide..	1'062	0'007
Lime	39'168	0'699
Magnesia	0'987	0'035
Sodium oxide ..	1'276	0'021
Potassium oxide ..	0'967	0'010
Sulphur	2'074	0'065

99'194

The ratio of the oxygen in the bases to that in the silica is about 6 : 10, the slag approximating to a simple metasilicate of calcium. While the general composition is quite different from that of *lapis lazuli*, the resemblance in colour and reaction with hydrochloric acid strongly suggest the probable presence of the same or an analogous compound of sulphur with the one to which the fine blue tint of that mineral is generally ascribed. There is enough of the alkaline metals present to allow of the existence of their sulphides, according to the older view of the constitution of *lapis lazuli* and ultramarine, and more than enough aluminium for its sulphide assumed by Stein to be the cause of the colour.

- (5). *Analysis of a Siliceous Crust on the Surface of Decomposing Obsidian from the East Side of St. Castagna, Lipari.* By Mr. J. A. CABELL.

A light grey obsidian, exposed to the action of heated sulphur dioxide, air, and vapour of water, had been decomposed to the depth of 10 to 12 m.m., producing a white, opaque, porous mass, on the outside of which a delicate, warty, and vesicular crust of 5 to 10 m.m. appeared, resembling hyaline, quite colourless, most of it transparent, some portions slightly milky.

This outside transparent crust was the subject of examination. Sp. gr. (in powder) = 2'062. Dissolved to the extent of one-third its weight by boiling for three

minutes with solution of caustic soda (20 per cent sodium hydrate).

After drying at ordinary temperature over sulphuric acid, from which no material loss of weight resulted, analysis afforded—

Silica	93'46
Alumina	0'37
Lime	0'74
Ferric oxide	0'37
Ferric chloride	0'15
Water lost at temp. above 100° C.	4'55
Water lost at 100° C.	0'08

99'72

The mineral is, therefore, opal silica—florit or siliceous sintra. The trace of chloride of iron comes in quite naturally from its volcanic origin. The amount of water retained after drying at 100° C. agrees very closely with the results of Gottlieb's experiments (*Journ. Prakt. Chem.* [2], vol. vi., 185-196) upon hydrated silicic acid artificially prepared by decomposition of silicon fluoride.

- (6). *Analysis of "Novaculite," or "Ouachita Whetstone," from Hot Springs, Arkansas.* By Mr. C. E. WAIT.

A very pure, snowy white specimen of this beautiful material, which has been fairly described by Dr. D. D. Owen in his "Second Geological Report on the State of Arkansas, as "equal in whiteness, closeness of texture, and subdued waxy lustre, to the most compact forms and white varieties of Carrara marble," of sp. gr. 2'649, proved to consist of—

Silica	99'635 (by diff.)
Alumina	0'113
Magnesia	0'087
Sodium oxide	0'165
Potassium oxide	trace
Iron	trace

100'000

The silica, or at any rate nearly all of it, appears to be in the crypto-crystalline, not in the amorphous or opaline form, as on boiling for three minutes with a 20 per cent solution of sodium hydrate but 1'63 per cent of the mineral was dissolved, and thirty minutes' boiling only led to 3'56 per cent being taken up.

- (7). *Analysis of Electric Calamine from Wythe County, Virginia.* By Mr. J. R. McD. IRBY.

This mineral was from the land of the late Mr. David Graham, on New River, about 10 miles above the point where it is crossed by the Atlantic, Mississippi, and Ohio Railway. It occurred in irregular masses, for the most part made up of contorted sheets 6 or 8 m.m. thick, botryoidal, and slightly stained by ferric oxide on the outer surface; pure white and nearly opaque, with radiated structure within; hardness, a little over 5; sp. gr., 3'338 at 21° C. It slowly and imperfectly gave up its water at 100° C.

In powder, and moistened with water, it dissolved easily in dilute hydrochloric acid in the cold, the solution gelatinising on standing. With strong acid, it formed a jelly at once. Acetic acid also dissolved it in the cold.

Analysis gave, for the pure mineral previously dried over sulphuric acid at ordinary temperature—

Calculated for Zn ₂ SiO ₄ + 11,0.		
Silica	23'949	25'00
Zinc oxide	67'883	67'50
Water	8'133	7'50

99'965

Hence a calamine unusually free from traces of foreign substances, but with a very slight excess of zinc oxide and water.

University of Virginia,
Sept. 12, 1873.

ON THE ENERGIES OF THE IMPONDERABLES,
WITH ESPECIAL REFERENCE TO THE
MEASUREMENT AND UTILISATION OF THEM.*

By the Rev. ARTHUR RIGG, M.A.

(Continued from page 236).

TELEGRAPHY seems at present to have taken the most important position in the manifestation of the energy of electricity. Telegraphists therefore naturally consider how they can measure the energy with which they deal. If there are any connected with telegraphy present, perhaps they will remember that this is not a lecture on the present advanced state of telegraphy, nor on modern instruments; it is simply an attempt to make as clear to a general audience as is in the lecturer's power the principles which govern the uses and measurements of electricity in relation to telegraphy. To enter into details in reference to those laws which the electrician and mathematician have been enabled to propound, would be not only very injudicious, but very unsatisfactory. A sketch of the broad principles on which they are founded, and an illustration of the application of them, may prove more useful than an attempt to show how details of measurement have been accomplished.

The first question that presents itself is what may be called the measure of resistance. It was soon observed that electricity passed along certain metal wires more freely than other metal wires of the same size and length. The observation admitted of a very important utilisation. For example, suppose the wire now stretched from one end to the other of this room was one mile in length, and that the little apparatus with which electricity is being produced at this end could produce a certain result at the other end. Now, let us take another metallic wire of the same length, and suppose the result produced in this case is much less than in the first. It will be admitted, without any detailed experiment, that by shortening again and again, the second wire may be reduced to a length which permits the phenomenon at the end of the first wire to be repeated at the end of the second. Now measure the second; it is only one quarter of a mile. Try a third and a fourth wire; perhaps they are respectively reduced to one-eighth and one-tenth of a mile. Evidently there is some property in these wires which hinders, retains, or resists the progress of electricity. The property is called "resistance," and is available for very useful purposes. The British Association for the Advancement of Science were so conscious of this that, in 1861 and 1862, there were grave considerations as to what steps should be taken in order to assign a value to this resistance. You have seen how the quantity of electricity may be measured, but then that measured quantity had not to convey itself to a distance. It quietly, as it were, stayed at home and worked. When telegraphy entered then electricity had to travel to or act at a distance. This state of affairs rendered it very desirable to determine "resistance," from what is called first principles, that is to say, to deal only with the three units of measurement, mass, space, and time. It was useful, by some means or other, to get this resistance into the form of mass, space, and time. It was considered that if we could regard it as velocity we thereby involved both space and time, because velocity is measured by space and time. If one runs a mile in an hour, then it is only needful to divide one mile by sixty minutes, and the space run in one minute is known. That would be the measure, assuming the minute to be the unit of time. The British Association appointed a committee. The chief gentlemen concerned in the committee, and who had the designing of a mode of grappling with one of the most critical tasks of science, were Mr. Clerk Maxwell, now Professor of

Physical Science at Cambridge, Mr. Balfour Stewart, of Kew Observatory, now at Manchester, and Mr. Fleming Jenkin, now Professor of Engineering in the University of Edinburgh. Their experiments were carried on in King's College, and the scheme now to be very briefly described is found in the report of the British Association for 1863.

It may here be remarked that perhaps there have been no lectures ever given in this room of a more important and scientific character than a course of Cantor lectures on electricity by Mr. Fleming Jenkin. This course commenced in January, 1866, and will be found reported in the *Journals* published between the 2nd February and 2nd March, 1866 (inclusive). It is well to make further statement, that those lectures have frequently been appealed to by writers on electricity who regarded the phenomena thereof in the light of an accurate science.* The question, then, is, how are we to measure in velocity this resistance? How are we to convert that which is resistance in a wire into an electrical measure of velocity? [The lecturer here, by apparatus and diagrams, illustrated the principle upon which this mode of measurement was based, and in so doing referred to the currents passing through the room as already described.] At Kew there is a record of these currents kept continuously night and day, and it is found that they are changing every minute. The main object, then, of the committee of the British Association was to devise a plan by which they could ascertain the resistance that a given wire offers measured by comparison with the velocity of these currents. You may remember that Kater could not measure the law of gravity, owing to the fact that it was rapid in its actions, and he felt that he must have some means of causing that law to repeat itself. Kater adopted the pendulum, and recorded the number of times it oscillated in twenty-four hours, and thereby got at the law. If, instead of having a long wire and three others running along the bar, as in the apparatus before you, we had a ring of this kind, and caused that to revolve rapidly, say at the rate of 100 or 200 or even 1000 revolutions in a minute, we still get the laws of the magnetic force in the same way as described, similar to when the bar passed along the rods before you. This causes the magnetic force to act upon the needle, and in reality, in the experiments which determined what is called "the British Association unit of resistance," these currents acted upon a very small needle carefully suspended, so that they were enabled to estimate the resistance of this wire in an absolute measure of space and time. That led to the adoption of what is called the "ohm," or "British Association's unit of electrical resistance." This term "ohm" is a name given in compliment to one who suggested an important relationship among the elements of current, force, and resistance. Indeed, that table of electrical measurements which may some day be placed in books of arithmetic, with corresponding tables of weights, measures, and money, will be found to contain the names of men who have investigated special departments of electrical science, such, for example, as Ohms, Farads, Volts, Webers, &c.

In this little glass cylinder there is a coiled length of German silver wire, German silver being used because it possesses great resistance to electrical currents, and that resistance does not change much with change of temperature. This coil constitutes what is called half a British Association unit, which becomes the measure of electrical work, just as the standard pound becomes the measure for weight, or the foot is the standard measure for length. Being possessed of this measure, we have all that is needful for the measurement of resistance, and

* Since the commencement of the publication of this course of Cantor lectures, a volume has been issued, entitled "Electricity and Magnetism," by Fleming Jenkin, published by Longman and Co., price 3s. 6d. In this volume the author has treated the subject in a novel and a practical manner, very different, indeed, from ordinary text-books on electricity. It will be found to contain matter of great value and interest to the thoughtful student of electricity.

* The Cantor Lectures, delivered before the Society of Arts.

therefore for measuring electrical work connected with telegraphy.*

To show the way in which a knowledge of this measurement can be utilised, rather than to enter upon those investigations by which it was obtained, seemed likely to win so much more attention and interest that these arrangements before you are for this purpose. The intention is to show how electricians determine the distance at which a deep sea cable is broken, so that they can tell how far the fracture is from the shore. Let it be understood that it is the illustration of a principle, and not the nature and modes of dealing with different kinds of "faults," that are to be our concern.

There is a wire, which may represent a cable, round the room. In this box there is placed a number of "ohms" arranged in three sets of nine each, so that by moving these pegs a current of electricity can be caused to pass through either one or more of them. Assuming each "ohm" in the first set to represent one resistance, each in the second set ten, and each in the third set one hundred, the consequence is that, if a current of electricity passes through all, it would meet with a resistance of 999. If it passed through one of the first set, it would only be one resistance; so that, with the moving of these brass pegs, there is the power of bringing in any number of ohms required. This flat board, about 3 ft. 6 ins. long, with a German silver wire and broad bands of copper divided at intervals, but capable of being put into electrical connection by the insertion of pieces of metal, constitutes what may be called the beam of electrical scales. Resistance, however, is to be measured instead of weight. Along a wire at the back, electricity can pass, and, when connected with the galvanometer, the speck of that instrument serves the same purpose as the pointer of a pair of scales. If the galvanometer speck points to nothing, we assume that there is equilibrium between the resistances at each end of the scale beam. If I put 999 "ohms" in what we may call one scale, and other resistances into the other scale, or that which we may consider as such, then, if the current of electricity, arranged as provided, can pass one of these groups of resistances more freely than the other, the speck of light will be moved. This is the same as though one end of a scale beam were "kicked up." Therefore, resistances, which in this case act the part of weights on ordinary scales, must be taken out or added as may be required.

This wire running partially round the room represents a cable. The two ends of this cable are in my hand. Let us assume that we want to measure the resistance the cable opposes to the energy of electricity, and to ascertain the value of its opposing power. Here is what is usually called a battery, consisting simply of a little salt and water, in a very small tumbler glass. "Battery" is a very misleading name in these days. This, with all its belongings, is really not worth sixpence, and it certainly seems a piece of pedantic magniloquence to call it a "battery."

The wires from this battery are so arranged that the current may divide itself between the cable that is round the room and this box of "ohms."

It may perhaps make the illustration more intelligible to those who have not familiarised themselves with terms of electrical science if for a while this current be regarded as consisting of passengers. Let it be represented by 200 passengers setting out from this battery, and having the choice of two routes, viz., one by the cable, and one by this box of ohms.

If the two routes are equally free, i.e., offer equal resistances, then fifty of these passengers will pass by one way and fifty by the other. Suppose that the resistance of one route (say the cable) is greater than that by the other route. Then that other route, or the way through

the box of ohms, will be available for some of those passengers who cannot readily pass by the cable. Here is a wire connecting these two routes; indeed the large letter A may convey a clear idea of the plan. Consider what is likely to happen if fifty of these electrical passengers set off from the top of the A down the thick stroke, and fifty down the thin stroke. We may say that those passing down the thin line cannot pass so freely as those down the thick one. Hence, finding the course down the thick line clear, some of these delayed passengers by the thin line may avail themselves of this cross-wire bridge, viz., the stroke in the A, and go to the place appointed for them by passing down the thick stroke. In this homely illustration the thin stroke is the cable—the thick stroke is the box of ohms. Clearly by moving these brass pegs, the resistance in the box of ohms is increased; that is, the thick stroke of the A is made more nearly the same as the thin stroke. Now introduce into this cross-way—the by-path, as it were—the galvanometer. Then if any electrical passenger avail himself of this by-road, the bright speck of light will tell the tale, and by noticing whether the speck moves to the right or left, the direction in which the passenger travelled is known, and therefore the electrical pathway which offers the greatest resistance is also known. By moving the pegs in the box of ohms, an equality of resistance may be established, and then passengers will not pass along the by-way through the galvanometer; therefore the speck of light will not move.

Nor is this indication of an electrical traveller the only use which may be made of the galvanometer speck. You are aware that the extent of deviation of this needle is the measure of the quantity of electricity in transit; therefore the extent of deviation tells the number of passengers; in fact, the galvanometer becomes an electrical tell-tale turnstile for counting the number passing through, and so indicating or measuring the difference in resistance between the two courses.

Let us leave this figurative mode of expression. In the experiment before you the pegs in the box of ohms read 505; the speck of light is steady; therefore we know that the entire length of cable, of which the two ends are here, also offers a resistance of 505. Before this cable was laid a comparison with these ohms had been instituted, and it was found (say) that one mile of the cable offered a resistance to the passage of electricity equal to one ohm, therefore there are 505 miles of cable, because there are 505 ohms.

Now let us break the cable by cutting the wire. There! one end has fallen to the bottom of this large pan of salt and water. This pan must, for the present, be looked upon as an Atlantic Ocean, one end of the cable is at the bottom of it, and we wish to know how far from the end in my hand the separation has taken place. To compensate for the portion of the cable hitherto used, but now detached, the earth is available; this sheet of copper, in and on the shore of our Atlantic Ocean, is buried. Soldered to the copper is a wire, of which the end is in my hand.

There are therefore in my hands the ends of two wires; one, that of the broken cable—the other, that connected with the buried sheet of copper. Let us deal with them as we did with the complete cable. [After various trials the pegs in the box of ohms were so arranged that the speck of the galvanometer was steady.] The speck is now steady, and the pegs read 350. This means that there are 350 miles of cable, or its equivalent. Now, the cable and the earth are the only elements on the one side; and since the earth is as a large reservoir of electricity it offers no appreciable resistance; hence the only resistance is that of the broken cable. The length of this is pointed out as 350 miles; this, therefore, is the distance of the fracture from the shore.

It is, perhaps, superfluous to state that many circumstances arise differing from those described, and many precautions have to be taken to which no allusion has

* Those who are disposed to give the thought and application requisite for a clear comprehension of these principles of electrical measurement may refer to chapters ix. and x., extending from page 147 to page 165, in *Jenkins's Electricity and Magnetism*.

been made. If, however, the general principles be made clear, that is accomplished which was intended to be done, and those who are desirous of further information may consult the higher class of books which treat on practical telegraphy. It may be of some interest to let you see how delicate and perfect a test even this loaded galvanometer speck is. One or two illustrations will show how electrical currents are set in action when we are at least aware of them.

Here is a small piece of zinc, like the blade of a pen-knife, attached to one end of a wire passing round the galvanometer, and here is a piece of copper attached to the other end. The zinc is now pushed into this apple. Observe, the speck moves so soon as the copper enters the apple. Repeat the experiment with a potato; the same phenomenon takes place. The potato forms a very good battery. There is another mode that is really more extraordinary still. If the galvanometer were sensitive, it is no fiction to say you can send a kiss across the Atlantic. Here are two little bits of zinc and copper attached to the ohms and cable combined as one length, and the galvanometer is now in circuit with them. If I kiss these two ends, the speck moves. Therefore, that mysterious something which is called electricity, and which has its origin at the lips, has exerted an energy sufficient to move the needle; indeed, sufficient to travel by the cable from one side of the Atlantic to the other, and move a needle when it arrives there.

Again, here is a small beef-steak and a knife and fork. These latter are connected by two thin copper wires with the galvanometer. One wire is attached to the blade of the knife, and the other to the prong of the silver fork; by watching the speck, you see that even one mouthful of meat cannot be cut without causing a current of electricity quite sufficient to manifest itself on the other side of the Atlantic.

Thus, surrounded by ever-active phenomena, which seem to have escaped the notice of men until the present age, he would indeed be more bold than prudent who ventures to speak confidently of what may or may not be done by one or other of the energies of the imponderables. How novel and delicate are the instruments employed, how accurate are the measurements obtained, and how marvellous are the uses to which electricity has been applied; yet these are not consequences of a blind rule-of-thumb following of that which has been long known. Patient research, persevering labour, and much thought have not only "put a girdle round the earth," but they promise fair to enter upon and possess electrical territories of vast extent and luxuriant social fertility. When will the people of England recognise this? Echo answers, "When!"

(To be continued.)

CORRESPONDENCE.

PUBLIC ANALYSTS.

To the Editor of the Chemical News.

SIR,—I should like to ask chemists whether they think that the remuneration given to Public Analysts is sufficient in most cases, either to induce men of ability to undertake the duties, or to induce young men at college to study that branch of chemistry with a view of filling the post of Public Analyst. My opinion is that it is not; the fees and salaries paid, either or both, as the case may be, are miserably low in the extreme; and no man could undertake the duties who has not other means of making a comfortable living, and such being the case it is evident that he can give but a small portion of his time to the duties connected with his office. Hoping to hear the opinions of some experienced chemists,—I am, &c.,

P. S. G.

ALUM IN BREAD.

To the Editor of the Chemical News.

SIR,—In an editorial postscript to a letter in the CHEMICAL NEWS, vol. xxviii., p. 262, you promise an article on the detection of alum in bread. As in the letter to which your note is appended reference is made to what is termed the "Shoreditch Case," I trust that you will not hastily assume the truth of the incorrectly-reported, and *ex parte* statements which have been published of the proceedings at the Shoreditch Vestry with respect to the analysis of bread.

Till the Select Committee has reported on the allegations made against me, I may fairly assert that no proof has been as yet forthcoming that I have had any bread adulterated with alum sent to me for analysis from Shoreditch.—I am, &c.,

THE SHOREDITCH ANALYST.

November 22, 1873.

[We have also received a letter from Prof. Gardner on this subject, which, however, arrived too late for publication.]

IRON IN TEA.

To the Editor of the Chemical News.

SIR,—In the CHEMICAL NEWS, vol. xxviii., p. 259, there appeared an article by Mr. W. Mattieu Williams on "Iron Filings in Tea," and as a public analyst who has devoted some attention to the tea question, I regret that I differ materially from Mr. Williams on some points.

It appears to me that your correspondent has formed his opinion wholly from what he has read, and has not personally examined any of the so-called "iron filings" from tea. I have come across several specimens of tea containing genuine iron filings, soluble in nitric acid with effervescence (magnetic oxide is scarcely soluble in nitric acid), and in one instance found real lumps of metal.

Thus it is a mistake to suppose that the metal is always introduced as filings, and I am surprised that Mr. Williams, with his Sheffield experience, should lay so much stress on the trouble of obtaining finely-divided iron. I have no doubt I could beg a hundredweight to-morrow. Still there is little doubt that in some instances the magnetic matter has consisted of the native oxide, and I have at the present time a tea under examination which contains the iron in this very form. But, remembering the refractory character of native magnetite or hematite, it seems very improbable that it would be appreciably acted on by a weak vegetable acid like tannic acid, though the hydrate formed by the rusting of introduced metal would readily react.

But the difficulty of introducing iron filings or borings is considerably over-rated. If it pays to introduce from 3 to 8 per cent of quartz pebbles, as large as the V of the "VOL." on the title-page of the CHEMICAL NEWS, and to roll them up in the interior of tea leaves, as seems to be the usual practice with low-class "capers," it would surely answer with iron, which has a higher specific gravity and possibly some chemical action. We can understand the tea plant to become dusty, as our gooseberry and currant bushes do in England, but that 5 per cent of little stones could adhere to the leaves throughout the process of picking is incomprehensible.

Mr. Williams appears to consider that an addition of 5 per cent of a substance not injurious to health ought not to be considered an adulteration. But if a half-crown tea contain 5 per cent of stones, the purchaser pays 1½d. for rubbish, and is certainly defrauded to that amount. In many businesses the seller is content with 5 per cent profit.

But the iron is not always present in the metallic state or in the condition of native oxide. In several instances I have found considerable quantities of soluble iron com-

pounds, no doubt added as a "dye," as Mr. Williams would probably call it. Now the popular judgment of the strength of a tea being founded on the depth of colour possessed by the infusion, the effect of the addition of sulphate of iron is to give the tea a fictitious strength, and seems as unjustifiable an addition as that of cayenne to give a sulphuric acid to vinegar. In addition to this, the habitual drinking of strong chalybeate water is very unsuitable to most constitutions.

It is usual to credit the Chinese with the adulteration of tea, but I am much inclined to think that in some instances we should look nearer home.

The addition of sulphate of iron to tea is an adulteration of so eminently scientific a character that one is led to suspect the "dyer" to have belonged to a nation more highly civilised and alive to the advantages of applied science than the "Heathen Chinese" is generally supposed to be.

The difficulties which public analysts have had to contend with have been very considerable, owing to the want of definite and reliable processes for the detection of certain adulterations of tea, and the absence of sufficient data as to the composition of genuine tea.

Mr. Wanklyn has given us valuable information as to the ash of tea, and I have myself obtained more exact determinations of the percentage of tannin and theine, and so, as the necessity arises, the other doubtful points will no doubt find a solution; but during the attainment of analytical perfection the want of more definite information will prevent the detection of many cases of adulteration, and thus give a dishonest tea-dealer the advantage.

It is certainly much to be regretted that so many of the analysts appointed under the new Act are men to whom it would be useless to look for help in the elucidation of obscure questions, and it seems that we may even have bungling in cases where a mistake appeared impossible; but I think if chemists will look back on the work of the past year, they will find that the public analysts have given them valuable original information on many points, including milk, butter, and tea.—I am, &c.,

ALFRED H. ALLEN.

Borough Analysts' Laboratory,
Sheffield.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the manufacture of sulphate of soda and sulphate of potassa. James Hargreaves, Widnes, Lancashire, chemist, and Thomas Robinson, iron founder, of the same place. February 22, 1873.—No. 660. This relates to the production of sulphates by our direct action method. (1). Sulphur or salts are mixed with the chlorides previous to the mass being broken into pieces. (2). Solutions of salts of copper, zinc, manganese, or chromium, are added to the chlorides, preferably before the mass is dried, and broken into pieces. (3). Steam or atmospheric air is employed to displace the gases contained amongst the converted finished sulphate.

Improvements in the purification of syrups and sugar. Alexander Melville Clark, patent agent, 53, Chancery Lane, Middlesex.—(A communication from Louis Joseph Frédéric Marguerite, of Paris.) February 22, 1873.—No. 662. The invention relates to—(1). To the purification of syrups from beet-root, cane, or other sugar, by the action of acids on the saccharine juices in a boiling state, either in a vacuum or otherwise. (2). In the treatment of saccharine juices for extracting crystallisable sugar therefrom, preferably by the aid of sulphuric or hydrochloric acid, by boiling in a vacuum at a low temperature. (3). To the use of like means for purifying molasses. (4). To improving first, second, and third quality sugars by like means.

Improvements in the composition of artificial marbles, slates, and cements of every kind, in making them firmer, harder, less absorbent, and more able to bear exposure to air, water, and other influences, than hitherto, which improvements are applicable to the making of paints, and as a substitute for marble and other like fabrics. Samuel Rowbotham, operative chemist, 21, Leighton Road, Kenning Town, London, and George Richardson, Chignal Hall, Chignal St. James, near Chelmsford, Essex. February 24, 1873.—No. 684. The use of albumen in mixing with the mass of paint or other substance and its coagulation by heat, or by any other means capable of effecting such coagulation.

An improved method of obtaining photometric measurements, and apparatus for that purpose. Major Francis John Bolton, 21, Grosvenor Mansions, Westminster, Middlesex, and Major Charles Edmund

Webber, R.R., 91, Cornwall Gardens, Kensington, Middlesex. February 24, 1873.—No. 686. This invention relates to a method of and apparatus for obtaining photometric measurements in terms of electrical measurement. A body, of which the electrical conductivity or resistance is altered by exposure to light, is placed in an electrical circuit, in which circuit is also placed an electrometer or gauge of electrical resistance. Light is directed on the body, and the value of this light, or the transparency or density of any translucent substance through which the light is passed is tested by the effect on the electrometer or resistance gauge.

Improvements in boiling wood or other fibrous material for the manufacture of paper, and in the treatment of the waste liquor. James Abraham Lee, Severn Engineering Works, Lydney, Gloucestershire. February 24, 1873.—No. 693. This Provisional Specification describes the use of an exhaust pump to discharge the air contained in the material, and so replacing it with caustic solution. Also the addition to spent liquor of acetic acid to form a valuable product and solid residue. Also the addition to spent liquor of other acids, with a similar object.

An improvement in the manufacture of candles, matches, and other like articles, together with a lamp or apparatus for burning such candles. Alexander Melville Clark, patent agent, 53, Chancery Lane, Middlesex. (A communication from W. J. S. Grawley, Paris.) February 25, 1873.—No. 703.

This invention relates to the application of naphthalene—(1). As a substitute for sulphur, wax, resin, or other inflammable materials used for dipping or impregnating matches and firelighters. (2). As an addition to the phosphorus paste in which the ends of wax and other matches are dipped. (3). To increase the inflammability of candles, tapers, lamps, and other articles, by dipping the same in the form of a hollow candle, provided with an independent wick and double air current, the flame serving to melt the solid naphthalene to feed the wick.

An improved mode of process of preserving meat. Engine Midge, and Félix Nicolas Cyprien Vuibert, both of Boulogne-sur-Mer, France. February 26, 1873.—No. 710. This invention relates to a method or process of preserving meat in bulk in its fresh, uncooked condition. The animal is killed by felling, and immediately skinned and cleaned. It is then glazed over with a preparation of sugar and alcohol and placed in a case in a bed of fat. The case is exhausted of air and soldered up.

Improvements in the manufacture of size. Robert Kay Whitehead, bleacher, Walmersley, near Bury, Lancashire. February 28, 1873.—No. 743. The object of my invention is to prevent mildew in yarns, woven fabrics, and other fibrous substances or materials, and it consists in combining a certain quantity of mustard oil or other vegetable oil possessing similar antiseptic properties with the size, in any amount or other size, which is applied to the yarns, woven fabrics, or other fibrous substances or materials for the purpose of stiffening them.

An improved artificial fuel. Thomas Cadett, Rosherville, Kent. February 28, 1873.—No. 747. Peat, turf, or bog is combined either with tar, pitch, resin, asphaltum, or other resinous or bituminous substance, or with oil. The peat or turf is first dried by exposure or by artificial heat, and is then immersed in one or other of the above substances and submitted to pressure in a mould, to thoroughly impregnate it with the tar or other substance and express any superfluous. After being again dried it is fit for use.

NOTES AND QUERIES.

Removing Black Dye.—If any of your subscribers could give me the best and cheapest way to remove the black dye from worsted that has been dyed black, they would confer a favour.—A. Z.

Orchill.—I should be very glad if any of your correspondents could favour our readers of the *Chemical News* with an article on the manufacture of orchill. I have taken your valuable paper a long time ago, and have never seen it mentioned. It is becoming an important manufacture in Leeds, for in 1860 there were only three works, and now there are eight, employing nearly 200 hands.—A. Fook

WORKING LAD STRUGGLING FOR PROGRESS.—In the explanation of the "simple and ready" method described by me in the *CHEMICAL NEWS*, vol. XVIII, p. 248, I did not perceive any claim to absolute originality, but that it was worthy of note is proved by the fact that it found place in the columns of the *CHEMICAL NEWS*. Permet me say chemical processes by rule-of-thumb, as is generally the case in metallurgical laboratories, probably do not test the purity of their reagents, from whence, doubtless, arises the discordance of their results.—CHARLES H. FISKE.

MEETINGS FOR THE WEEK.

- MONDAY, Dec. 1st.—Royal, 4. Anniversary.
— Royal Institution, 2. General Monthly Meeting.
— Medical, 8.
— London Institution, 4.
- TUESDAY, 2nd.—Civil Engineers, 8.
— Photographic, 8.
— Anthropological Inst., 8.
— Zoological, 8.
— Anthropological, 8.
- WEDNESDAY, 3rd.—Society of Arts, 8.
— Geological, 8.
— Microscopical, 8.
— Pharmaceutical, 8.
- THURSDAY, 4th.—Chemical, 8.
- FRIDAY, 5th.—Geologists' Association, 8.

SUPPLEMENT
TO
THE CHEMICAL NEWS.
Vol. XXVIII. No. 731.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, November 20, 1873.

Dr. ODLING, F.R.S., President, in the Chair.

THE names of the visitors having been announced, and the minutes of the previous meeting read and confirmed, Messrs. John Turner and G. Bulk Francis were formally admitted Fellows of the Society.

The following names were read for the first time—Messrs. Edward H. Davies, Sydney Trivick, John Smyth, M.A., Edmund Richard Southby, Edward Daniel Stone, John Sutherland, Carl Schorlemmer, F.R.S., and John Clement Smith.

For the third time—John Douglas, Esq., who was ballotted for and duly elected.

The first paper, "On the Coefficient of Expansion of Carbon Disulphide," by J. B. HANNA, was then read by the Secretary. It contains the results of a numerous series of determinations of the specific gravity of carbon disulphide at small differences of temperature made in an apparatus of peculiar construction, so as to prevent evaporation, and to admit of the subsequent expansion of the liquid when adjusted at low temperatures. When the apparatus was carefully cleaned, the disulphide could be heated in it considerably above its boiling-point, thus affording a means of obtaining its specific gravity at comparatively high temperatures. The temperature of the specific-gravity bulbs was adjusted by immersing them in water kept at a constant temperature by a modified form of Carnichael's apparatus. Two tables of the calculated and observed variation from 0° to 62° C. in the volume and specific gravity of the disulphide, the latter referred to water at 4°, accompany the paper. From the results the author concludes that carbon disulphide expands equally for each equal increment of temperature, the number denoting the coefficient of expansion being 0.001129, and that denoting the decrease of specific gravity 0.001461 for each degree Centigrade.

THE PRESIDENT said the thanks of the Society were due to the author for his communication, and also for the new form of specific-gravity bottle he had introduced to their notice.

Dr. MILLS remarked that, if the coefficient of expansion of carbon disulphide were the same for a considerable range of temperature, it would differ in that respect from every known liquid, as their expansion was represented by a function of the third degree. The speaker had had some experience in working with delicate thermometers, and would like to ask how the temperature was determined. It was well known that the zero point of new instruments varied considerably from day to day, so that, although an accurate determination might be made with the corrected thermometer to-day, at the end of a week there might be a comparatively large error if the same correction were employed. In determinations giving such abnormal and extraordinary results, he details of the thermometric corrections should be given.

Professor G. C. FOSTER pointed out that the author had stated that the specific gravity of the liquid diminished by a constant number for each equal increment of temperature; now, if this were true, it was obvious that equal decrements of specific gravity would not give equal increments of

volume, and it was therefore impossible that the expansion should be constant; there must be some error in the calculations.

THE SECRETARY said no details were given in the paper of the precautions taken in determining the temperature.

A paper, "On the Action of Hydrogen on Silver Nitrate," was then read by the author, Dr. RUSSELL, F.R.S. He finds that thoroughly washed and purified hydrogen causes a precipitate of metallic silver from a solution of silver nitrate, the precipitation occurring much more readily in saturated than in dilute solutions. The gas employed was usually procured by the action of a saturated solution of copper sulphate on zinc, or by the action of water on a mixture of powdered zinc and tin; after it had been passed for about half an hour through a saturated solution of the silver salt, a dull greyish deposit is produced, which is succeeded by a bright crystalline precipitate. This precipitation is quite independent of the action of light, but is increased by heat; a clear solution, through which hydrogen had been passed for a minute, became turbid, and gave a precipitate of silver when heated. Similar effects were obtained when the solution was exposed to an atmosphere of hydrogen, instead of causing the gas to bubble through it. The author has conclusively proved that these phenomena are caused by the hydrogen displacing the silver in the silver nitrate, producing hydric nitrate, but a secondary reaction also takes place between the nitric acid and the precipitated silver, resulting in the formation of silver nitrite, and, as silver nitrite is not decomposed by hydrogen, the end product formed would be silver nitrite. Dilute solutions of nitric acid have little or no action on metallic silver, so that hydrogen precipitates silver as readily in a solution containing 7 per cent of nitric acid as from an aqueous solution; on the contrary, even very dilute nitric acid, if it contains a trace of nitrous acid, readily dissolves the metal. Platinum, palladium, and gold are completely precipitated from their solutions by hydrogen. Copper nitrate is reduced to nitrite, whilst mercuric nitrate deposits a basic nitrate.

Dr. ODLING thanked the author for the very complete manner in which he had investigated this subject of the precipitation of silver by hydrogen.

Professor MASKELYNE said the experiments of Dr. Russell were particularly interesting to mineralogists, and might throw some light on the relation between the circumstances under which the substance was precipitated and its crystalline form, as it was far easier to ascertain facts than to give satisfactory explanation of them; for instance, why did sulphate of barium occur in a particular district crystallised in one set of forms, and in another district in another set of forms? In order to get some insight into this matter, the conditions of the formation of crystals must be carefully observed. He had examined the crystals of silver, and found them to be octahedra; the filamentous form consisted of chains of octahedra.

Dr. C. R. A. WRIGHT had listened to the paper with great interest; when endeavouring to determine the sulphur in iron, by dissolving it in acids, and passing the evolved gas through various metallic solutions—and, amongst others, ammoniacal nitrate of silver,—he had found more silver was precipitated than corresponded to the sulphur in the iron. He would like to ask Dr. Russell whether he had tried the action of hydrogen either on ammoniacal silver nitrate or on the solid nitrate itself.

Professor WILLIAMSON said there was a point of some interest connected with the paper—namely, as to hydrogen being more soluble in a solution of silver nitrate than in pure water. According to Dr. Russell, about half an hour elapsed before the silver began to be precipitated, so that there might be time to ascertain the amount of hydrogen dissolved. As the solubility of hydrogen in water diminishes with rise of temperature, it was conceivable that hydrogen also dissolves less freely in hot solution of silver nitrate than when cold. This would afford an explanation of the precipitation of silver from the solution when it was heated. Supposing the silver is only precipitated when

the solution is saturated with hydrogen, the cold solution, not being saturated, would give no precipitate, but, on heating it, silver would be precipitated as soon as the saturation-point was reached.

Dr. RUSSELL replied that he had not as yet made any determinations of the solubility of hydrogen in nitrate of silver solution. He had also forgotten to say that he had found that, when air was excluded, the product of the action of silver on nitric acid was silver nitrite.

Dr. C. R. A. WRIGHT read a "Note on the Action of Zinc Chloride on Codeine." In attempting to prepare apocodeine for the market, according to the process of Matthiessen and Burnside, by acting on codeine with zinc chloride, Mr. D. Brown obtained a product which possessed most of the properties ascribed to apocodeine hydrochloride, but which, when analysed by the speaker, was found to be isomeric with codeine hydrochloride; in fact, at low temperatures, the chief product is a loose compound of zinc chloride with the hydrochloride of the base *tricodeine*, and, if a longer time of heating be adopted, or a higher temperature, *ultracodeine* is also formed. The author thinks that Matthiessen and Burnside's apocodeine was an alteration product, due to the action of hydrochloric acid on the tricodeine first formed.

Dr. ODING having thanked the author for his communication, a memoir "On the Chemical Properties of Ammoniated Ammonia Nitrate," by E. DIVERS, M.D., was read by the Secretary. In this paper the author describes the action of the liquid produced by the deliquescence of ammonia nitrate in an atmosphere of dry ammonia on various elements and compounds, comparing the results with those obtained by Gore with ammonia liquefied by pressure. As a rule, these properties appear to be the result of the joint action of the two constituents of the liquid—namely, ammonia and ammonia nitrate; the latter, as might be expected, considerably modifying the action of the ammonia. The behaviour of the liquid towards upwards of 150 substances was examined, including most of the elements, the metallic chlorides, oxides, and sulphides, also some bromides, iodides, nitrates, carbonates, chromates, &c.

The President having thanked the author in the name of the Society, a note "On the Analysis of a Meteoric Stone, and the Detection of Vanadium in it," by R. APJOHN, was read by the Secretary. After alluding to former analyses of meteoric stones, and enumerating the elementary bodies present in them, the author draws attention to the fact that the proximate constituents of meteorites are generally the same as those of trap-rocks, and, since vanadium is found in the latter, it might possibly also exist in the former. An examination of a meteoric stone which fell, in 1810, in the county of Limerick, showed that it contained vanadium. A complete analysis of the stone is given, and the analytical methods employed are described in detail.

After returning thanks to the author, the President finally adjourned the meeting until Thursday next, Dec. 4.

MISCELLANEOUS.

Exhibition of Appliances for the Economic Consumption of Fuel.—Practical and scientific inventions and improvements of all kinds bearing on the solution of the great fuel question are to be afforded the fullest scope for treatment at the forthcoming Exhibition of Fuel-Economising Appliances to be held by the Society for the Promotion of Scientific Industry. The following comprehensive classes of exhibits are now announced by the Council of the Society:—(1). Appliances which may be adapted to existing furnaces, &c., whereby an improved combustion of the fuel is secured, and a direct diminution in the quantity required is effected. (2). Appliances which may be adapted to existing steam boilers, &c., whereby the waste heat of the flue gases or of exhaust steam is utilised, (3). Appliances which may be adapted to existing steam-

boilers, pipes, and engines, whereby loss of heat from radiation and conduction is prevented. (4). Appliances which may be adapted to existing steam-boilers and engines, enabling them with safety to realise the great economy resulting from the use of high-pressure steam or superheated steam. (5). New or improved furnaces (using solid, liquid, or gaseous fuel), boilers, and engines of all descriptions, specially adapted for the saving of fuel. (6). Apparatus which, by producing a cheap and abundant gaseous fuel, will supersede the costly carriage of coal, obviate the present enormous waste attending its use in the solid form, and condense and save the valuable sulphur, ammonia, and other by-products of the distillation, now injuriously affecting iron- and other smelting processes, and, in a vast number of operations, discharged as poisons into the air. (7). Apparatus or engines for obtaining power advantageously from heat through any other medium than steam. (8). Natural and artificial fuels of all kinds. (9). Coal-cutting machines; peat-manufacturing machines. (10). Domestic and other fires, stoves, ranges, and apparatus of all kinds (using coal, gas, or other fuel) for cooking, and for warming rooms and buildings. (11). Mechanical or other arrangements for securing the delivery of proved weights of fuel to the domestic consumer. The Exhibition is to be held in Manchester, and will be opened on December 15th, by the Rt. Hon. the Earl of Derby, F.R.S., President of the Society. In consequence of the large amount of space that has been applied for, the Council of the Society has determined to increase the size of the Exhibition Building, and to include the appliances named in 9, 10, and 11 as above.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopaedic list of chemical papers published abroad during the past year with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, October 20, 1873.

Production of Certain Crystallised Borates by the Dry Way.—M. A. DITTE.—(Continued from page 783.) The author has formed and examined the diborate of baryta, $\text{BaO} \cdot 2\text{BoO}_3$, containing—

Baryta	52.37
Boracic acid	47.63

and also the sesquiborate, $2\text{BaO} \cdot 3\text{BoO}_3$, which contains—

Baryta	58.46
Boracic acid	41.54

A magnesium salt was obtained, containing—

Magnesia	30.00
Boracic acid	70.00

and answering to the formula, $3\text{MgO} \cdot 4\text{BoO}_3$, which corresponds exactly to that of the native boracite of Brunswick occurring in the gypsum which forms interposed masses in the chalk formations. Another compound obtained, $3\text{MgO} \cdot 2\text{BoO}_3$, is analogous to the basic borates of strontia and lime. The neutral salt, $\text{MgO} \cdot \text{BoO}_3$, contains—

Magnesia	36.85
Boracic acid	63.15

The author also obtained certain double borates, as a double

borate of lime and magnesia, $(3\text{CaO}, 2\text{BoO}_3)(3\text{MgO}, 2\text{BoO}_3)$. A double borate of strontia and magnesia was found to have the composition, $(3\text{SrO}, 2\text{BoO}_3)(3\text{MgO}, 2\text{BoO}_3)$. The analogous barytic compound was not obtained.

Chloro-Vanadates.—M. P. Hautefeuille.—The reproduction of vanadinite, and the preparation of a Wagnerite containing vanadium, have enabled the author to show that the vanadates, like the phosphates and the arsenates, form two series of isomorphous salts in combination with chlorides. Vanadinite was formed by heating to dull redness pure vanadic acid intimately mixed with litharge, and with a large excess of lead chloride. After cooling and dissolving out the chloride of lead we obtain yellow transparent needles of a fatty lustre. These crystals, like the natural product, contain 3 equivalents vanadate of lead to 1 of chloride. The chlorides capable of uniting with the vanadates when fused are not numerous, the greater part being decomposed by vanadic acid. This is the case with the chloride of magnesium. The chloride of calcium, on the other hand, forms a chloro-vanadate of lime if heated moderately with the needful ingredients. It forms, when freed from excess of chloride of calcium, crystals of a dead white, and of an adamantine lustre. They contain—

Vanadic acid	.. ..	39.07	1 equiv.
Lime	.. ..	36.66	3 "
Chloride of calcium	.. ..	23.75	1 "
Loss	.. ..	0.52	

100.00

This salt, when crystallised, does not belong to the same type as vanadinite; it is not an apatite, but has the composition of the wagnerites, containing equal equivalents of vanadate and of chloride.

Mode of Producing Methylamins in the Manufacture of Pyroigneous Products.—M. C. Vincent.—Crude pyroigneous acid saturated with slaked lime before the separation of the methylic alcohol, and submitted to partial distillation, yields crude methylic alcohol; the first portions of which contain ammonia in considerable quantities, and some traces of methylamin. This alcohol, completely saturated with sulphuric acid, deposits a white, crystalline, non-deliquescent mass, insoluble in methylic alcohol, and readily crystallisable from water. If, instead of immediately collecting the alkaline methylic alcohol, it is submitted to rectification in an apparatus furnished with a cohobator, we obtain a product the first portions of which are rendered alkaline by a small quantity of ammonia, and a notable amount of methylamin. This alcohol, re-distilled several times in the same apparatus, contains only traces of ammonia; but, instead, considerable quantities of methylamin, dimethylamin, and trimethylamin.

Theorem Relative to the Movement of a Point Attracted Towards a Fixed Centre.—M. Bertrand.

"Astronomische Mittheilungen" of Dr. Rudolph Wolf.—M. Faye.—The connection of sun spots with magnetic variations is made very obvious in this work. With the aid of fellow-workers in Switzerland, Germany, Italy, and Greece Dr. Wolf determines, for every day in the year, the number measuring the frequency of the spots. From these numbers he can calculate the variations of declination of the needle at a given point on the earth's surface when two constants have once been determined for the place (as in calculation of tides). Thus, take Batavia, the constants are 2.130 , and 0.0185 ; the number, R , of the spots is connected with the variation in declination by the simple formula, $v = 2.130 + 0.0185 R$. From a list of the variations as observed, and, as calculated from the spots, it appears that the average divergence (in 1868-9) is only about $\pm 3''$. Dr. Wolf's observations justify the expression "cosmic meteorology."

Explanation of Solar Spots Proposed by Professor Reye, of Strasburg.—M. Faye.—Dr. Reye explains that waterspouts and cyclones are exactly the same kind

of phenomena as the small whirlwinds in our streets. They are due to the ascent of the lower layers of air when the vertical decrease of the temperature has become such as to render the equilibrium of the atmosphere unstable. Then the least accident will cause, here or there, the ascent of a puff; and once the movement has commenced the air of the lower layer flows towards this point. By the narrow orifice considerable masses then arise from all sides, widening more and more (upwards) the channel of ascent. The lower hot air, dilating in the upper regions, has part of its vapour condensed, and the heat due to this condensation, rendering it still lighter, adds to its ascensional force. Then, as to sun spots, Dr. Reye's view is that when a facula forms on the solar surface the extreme heat from it causes, in a limited region of the photosphere, the following phenomena:—The temperature of the atmospheric layer immediately resting on the facula rises, and renders the equilibrium unstable. The mass of gas and vapours composing this layer tends to rise into the upper layers. There may then be formed above the facula a sort of waterspout (*trombe*). The cooling which results causes condensation of vapours, and produces within the opacity necessary to mask the subjacent region of the atmosphere. This cloud may be 100 or 200 German miles in height. Below it, and laterally, gaseous masses will escape in conical sheets. Already partially deprived of this vapour, these will deposit much higher a number of small opaque clouds, which will form the penumbra. At length this gaseous mass, quite deprived of vapours by successive condensations, will fall violently above the chromosphere and outside of the penumbra in flames of nearly pure hydrogen. Dr. Reye does not dispute Wilson's celebrated observation that the spots are cavities, but he urges that this observation is as well satisfied with funnels situated above the sun, as with funnels situated in its very mass. On this M. Faye remarks as follows:—Suppose a circular vessel in the middle of a table to be viewed obliquely by an observer too far off to have perception of relief. He is required to decide whether the vessel is simply placed on the table, or inserted in a circular hole such that the whole body of the vessel is under the surface. He will perceive two ellipses which are not concentric. Now he can, by measuring on the perspective tableau the distance from the bottom of the vessel to two opposite edges, decide the question. If these distances are equal the vessel is exterior to the table; if the distance from the bottom of the vessel to the table-edge next the observer is the smaller, the vessel is inserted in the table. This principle, applied in solar measurements by Mr. Carrington, has shown that the cavity of the spot is always in the body of the sun. A second method is that of considering the upper orifice of the penumbra; and P. Secchi has found that the centre of this orifice does not undergo displacement, whatever its distance from the centre of the sun. Hence, the upper orifice must be level with the photosphere, and not 900 or 1000 German miles above it. A third and still more simple method is that of a sectional view. The vertical ascending "waterspouts" when they reach the border should be visible and brilliant during total eclipses. But it is not so. Besides, at ordinary times, the spots are observed to disappear at the border like simple holes, without indication of relief. All tends to show that the spots are not without the sun in its atmosphere, but in the thickness of its brilliant mass.

Easy Method of Measuring the Capacity of Ships.—M. D'Avert.

Production of Galls on Vines Attacked by Phylloxera.—M. Max Cornu.

Reproduction of Phylloxera Quercus.—M. Balbiani.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, October 27, 1873.

Action of Formiate of Soda upon Sulpho-Benzoeic and Benzoic Acids.—V. Meyer.—The author shows that

when formate of soda acts upon sulpho-benzoate of potassa in the manner which he adopted no terephthalic is formed. Sulpho-benzoic acid is converted by formate of soda into isophthalic acid, in circumstances in which no aromatic dicarbon acid arises from benzoic acid. Hence he concludes that the isophthalic acid formed on fusing sulpho-benzoate of potash with formate of soda arises from the direct replacement of the sulpho group by carboxyl, and not from the benzoic acid re-formed in the reaction.

Constitution of the Benzoic Series.—Victor Meyer.

—The author observes that no chemist will seriously maintain that the constitution of any chemical compound has been established with absolute certainty.

Decomposition Products of Bichloropropionic Ether and Amide by means of Lime.—A. Klimentko.

—The author declares that his results are as yet insufficient even for a preliminary notice.

Utilisation of Platinum Residues.—Th. Knösel.

The author communicates a process for preparing chloride of platinum from platinum residues, and from the alcoholic washings. The precipitates are placed in a porcelain capsule, and are mixed with caustic soda, heated upon the water-bath, and the alcoholic washings gradually added. The reduction is rapid, and the metallic platinum is deposited in a spongy state. The reduction is at an end when the supernatant liquid appears almost colourless. It never becomes quite colourless, on account of the formation of certain organic compounds which impart a faint yellow tinge. The metallic platinum is repeatedly washed by decantation with boiling water, and then washed upon the filter till the red colour of chlorine disappears. It is then dried, heated to redness, and is then ready for further treatment. It is boiled in hydrochloric acid to remove impurities, and then dissolved in aqua regia, preferably in the water-bath. The chloride of platinum is repeatedly evaporated to dryness, and re-dissolved in boiling water to remove nitrous acid. Finally, the solution is bleached in direct sunlight.

Certain Constituents of Poplar Buds.—J. Pickard.

—The author corrects certain typographical errors in his communication in No. 13.

Revolution in the Soda Manufacture.—Rudolf Wagner.—The author gives the history of the gradual development of the "ammonia process," and a view of its advantages.

New Hydrate of Quinine.—A. C. Oudemans, jun.—The author found two samples of quinine containing 9 equivalents of water of hydration instead of 3, but was unable to explain their formation.

Molecular Deflecting Power of Tartaric Acid and its Salts.—A. C. Oudemans, jun.—A critique on Landolt's paper (*Berichte*, vi. p. 1072).

Nitro-Compounds of the Fatty Series.—Victor Meyer and C. Wurster.—The authors examine the action of sulphuric acid—both fuming and ordinary—upon nitro-ethane, and also that of alcoholic potassa.

Peroxides of Barium, Strontium, and Calcium.—Remarks upon Mr. Convoys's paper (read before the London Chemical Society, June 5), with whose results the author generally agrees.

Communications from the Odessa Laboratory.—W. Markownikoff.—The author describes the conversion of diethoxallic acid into diethyl-acetic acid, the formation of polymeric isobutyl-aldehyde, the properties of cetone, and some methods of forming the compound ethers.

On Cyanide of Thallium.—C. Frömmüller.—The author found that the cyanide of thallium is readily soluble in water; easily decomposed by the carbonic acid of the air; that its aqueous solution is completely decomposed even in the absence of air; and that the compound cannot exist in the dry state at low redness. He obtained the cyanide by mixing a saturated and boiling solution of sulphate of thallium with its equivalent of a boiling saturated

solution of baryta, and filtering off the sulphate of baryta in a flask. When cold the solution of protoxide of thallium is mixed with an excess of concentrated prussic acid. After agitation alcohol is added in excess, and as much ether as will dissolve in the liquid. A heavy, amorphous, white precipitate falls down. It is freed from the mother-liquor by decantation, washed with a mixture of alcohol and ether, and dried under the air-pump. Its composition is—

Thallium	88.69
Carbon	5.21
Nitrogen	6.08

99.98

The solution of cyanide of thallium dissolves the cyanides of silver and zinc, forming double salts much more stable than pure cyanide of thallium.

Alizarin as an Indicator in Titration.—Eugen Schaal.

—The author finds that alizarin is far more sensitive than litmus, so that it shows distinctly $\frac{1}{100000}$ of alkali, whilst a neutral solution of alizarin, strongly diluted, is coloured yellow by $\frac{1}{10000}$ of hydrochloric acid. The author prepares his solution of alizarin by dissolving this substance in boiling potassa lye with a drop of carbolic acid, and filtering in the cold. The neutralisation of acidity is marked by a change from yellow to rose colour.

Various Communications.—F. Beilstein and A. Kupfer.

—The authors treat of the cymols of the oil of caraway, and of camphor; of cymol-sulphuric acid and its salts; of the oil of wormwood and its product, absinthol; on cuminic acid and its salts, and on the metallic derivatives of cyanamid.

Investigation of Cholic Acid.—F. Baumstark.—The author examines cholic-ethylic ether, cholemid, and cholic-benzoyl-ethylic ether. He finds that dialcyclic acid corresponds to choleidonic acid, and lactid to the product of the dry distillation of cholic acid.

Diphenyl-Acetic Acid and Benzilic Acid.—R.

Symons and Th. Zincke.—The authors examine the diphenyl-acetates of barium, calcium, zinc, and silver, and its ethylic ether. They consider it proved by their results that benzilic acid has the formula ascribed to it by Staedeler.

Synthesis of Tauro-Carbaminic Acid.—E. Salkowski.

—On leaving in contact taurin and cyanate of potash in equivalent proportions the mixture deliquesced at first, and in two days was resolved into a crystalline mass—the tauro-carbaminic acid of potassa.

Reimann's Färber Zeitung, No. 42, 1873.

This number contains a receipt for a logwood-blue on wool, which bears soap and, to a slight extent, fulling, 50 lbs. of wool are boiled for an hour with 1 lb. of yellow chromate of potash, 5 ozs. of sulphate of copper, and to ozs. of sulphuric acid, and allowed to lie overnight in the decoction. The next morning it is dyed in a fresh bath with 5 lbs. of logwood, 3 lbs. of prepared tartar, and 4 to 4½ lbs. of the coarsest neutral extract of indigo.

There follow receipts for a dark green on fine wools; a dark green on inferior goods; a Russian green; a vat green on wool; a drab-grey on old silks; a reseda on old silks; a brown on mixed goods; a red and white (printing) on a black ground; a pansy and a maize on silk; an olive; a reddish Havana and a yellowish Havana on plush; a chamois; crimson II.; crimson I.; rose III., II., and I. on wool (printing); and a ponceau on shoddy.

Discovery of Artificial Alizarin.—The original idea is assigned to Strecker, and to Graebe and Liebermann the honour of its practical execution.

Royal Institution.—At the General Monthly Meeting, to be held at 2 o'clock on Monday, December 1, a President will be elected in the room of Sir Henry Holland, Bart., M.D., D.C.L., deceased.

THE CHEMICAL NEWS.

VOL. XXVIII. No. 732.

A DISCOURSE ON ATOMS.

I SEE that some chemists are giving themselves a good deal of trouble by discussing the atomic theory without distinguishing between that of Leucippus and that of Dalton.

The first is open to discussion, and will long be. We must learn much concerning matter before we can say with certainty that it consists *primarily* of indivisible particles or atoms.

The second—namely, the theory of Dalton—is not, in my opinion, open to discussion, simply because no one has yet opened a door sufficiently large for a doubt to enter by. Is this a mere matter of opinion? So far as I see, it is not, and all chemists confirm it in practice, willingly or unwillingly.

Now why should one theory be doubtful, and the other not doubtful? The reason is clear enough to the writer, but it remains to be seen whether it will be clear enough to all. It is this. The physical atoms of Leucippus and his school are the least possible divisions of matter, or, if you please, the smallest created or existing parts. The atoms of Dalton are not necessarily so. They are only the smallest of which we may be said by reasoning on our experiments to know anything, and they may be for all we know, and they probably are, compound molecules. The atoms of Leucippus are indivisible according to theory; the atoms of Dalton are indivisible by our chemistry. As such, and as such only, can we view the atoms of Dalton. Dalton's theory is an expression of the facts of the science of chemistry, but the atoms of Leucippus, and Epicurus, Lucretius, Newton, and even Dalton himself, considered as a physicist, are no help to us. The Greek atom is still indivisible; the Daltonian is undivided.

Let us take a drop of water, and divide it as far as Nature ever divides it, and it still contains oxygen and hydrogen. Let us divide it as much as you can imagine it divided, and still it contains oxygen and hydrogen; you cannot even conceive a piece so small that it shall not contain these two elements. Yet it is an atom of water—one indivisible quantity, let it be large or small. Nevertheless, after you have gone as far as you can conceive, even to the size of one atom of one of the two elements in the water, if such a paradoxical idea pleases you, the atom is divisible into oxygen and hydrogen. You may follow this idea as far as you please, you make only this, that infinite divisibility is beyond our understanding, and, when we speak and think of it, we have always something finite in our minds. You divide even water, which you know to be compound, to any extent you please, mechanically, and then you have a chemical division beyond it. The division of a sea of water and an ultimate particle is one in science, and Dalton says, Whatever amount of water you choose to imagine, I say it has a definite quantity of O and H. Why is it so? The simplest reason I can find is this, definite bulks unite to form the compound; if the bulks were not definite, then mixtures of elements would occur of various kinds, and we might have an infinite number of compounds of H and O. The fact of definite compounds being constantly formed is a pre-

sumption of a definite size existing for the ultimate particles. But do you mean to say that an atom of salt may be supposed to lie at the bottom of a sea of water, supposing only one atom to be there? I mean, at least, to say that, if an infinitely small quantity of salt were put into a sea of water, it could not be dispersed equally over the sea without bringing in new and still more incomprehensible relations between one part and another. When a small quantity of oxygen fills a large space, we are obliged to suppose motion in the particles, an attempt to be in several places at once, and without this theory we have more difficulty. It suits our understanding, and the nature of the things we see, to say at once that an atom of salt may be supposed to lie at the bottom or top of a large quantity of water.

But, says an opponent, I look on the elements themselves as mere centres of forces, and, if so, there can be no atom.

Dalton might say: "They may be centres of forces for all I know, but that does not take away from them materiality; it is merely another mode of expressing matter."

Opponent: "Not exactly, because if there is only force, then it may be infinitely divisible, or, at least, it can be conceived so more readily."

Dalton: "I do not see this. If a piece of iron is proved to be a force, it is not the less a piece of iron. If an ultimate particle of water be proved to be two forces or more, it is not the less a particle of water, and divisible into H and O, which you may call gases or forces as you please."

Opponent: "But, if they are forces, then it may be that, when we find O and H uniting, it is an act of many unseen powers very complicated, none of them being elements, but making elements by combining."

Dalton: "That is the same supposition virtually as before, but remember it is a supposition, and I came to deliver you from many such fancies. If it be true, then I may assure you that these forces come in very definite quantities, and act as much by quantity as my supposed atoms do, and if they become solids they must be treated as such. Indeed my idea of obtaining definite compounds by bulks or ultimate parts has expanded itself into the idea of equivalents, a very useful word invented by that most ingenious chemist Wollaston, and my pupil Joule has extended it to force—its rational development. To me it matters not whether force be the original of matter or not, or whether force and matter be the same or not; surely I am quite well acquainted with such variations. Although I call Wollaston ingenious, I do not admire his word equivalent. It arises from a suspicion and unfamiliarity with the idea, or, as I would say, from ignorance."

Opponent: "But, then, if there is force only, and not bulk, to begin with, how do you get the combination to be definite?"

Dalton may say again: "I found it difficult, and therefore I kept to matter, which, however, may simply be the expression of force. I take it, however, in the shape given to me by nature. No one has ever shown me an oxygen-producing force in action. Still let us examine the proposition. If oxygen should occasionally split up into X and Y, forming two elements, it may be that all our other elements may do the same, or something similar; we might then have many more elements, or fewer, perhaps only one at last. That I think possible enough. We should then have a chemistry beneath our chemistry, a new era like that

brought in by Davy when he began the chemistry of the earthy and alkaline oxides. That newer chemistry may come, but it must apparently be caused by a new power, because we have tried to decompose our elements by the forces we have, and they will not yield. If one prefers to speculate on such a chemistry, let him do so; but do not suppose that any such result will alter the present theory as applied to present natural conditions."

It is clear that no one has yet explained how the smallest quantity of water, and the largest, should have a definite composition, except Dalton; and many men have tried it. If one O and two H's unite to form every conceivable portion of water, nature has given us no reason to suppose that these parts can be indefinite. The first conceivable portion of water being composed of two parts is not infinitely small. If you say that, both being infinitely small, two must be so also, I must demur; two things do not make a something, but two infinitely small bodies must, even to our imaginings, make something more definite. At the same time, however, I must remind you that we cannot understand the meaning of "infinitely small," and when we struggle we make in our minds a definite size. The same thing applies to "infinitely divisible." At the same time, this is not conclusive, only illustrative, and the best arguments lie in the fitness of the Daltonian atoms to make definite compounds. I object to have an intelligible theory put aside by an unintelligible, even on the supposition that perhaps it may some day be intelligible. Notwithstanding difficulties, men will rush at infinitely divisible matter, and form definite compounds out of it. By what means do they obtain the first idea of definite size? Dalton shows how he begins it. Let us learn another way of beginning it. How does volume come out of no volume? How does equivalent come out of shapelessness? It is as easy to throw clay into the fire unshapen, and to bring out bricks; it is as easy to decide how something came from nothing. We are compelled to seek a beginning for ourselves to rest on, uncertain whether a real beginning, to which we cannot attain, preceded that which we seem to comprehend. If you will go farther, and break up our chemical and intelligible atom into a theoretical one, you begin a new science; but you must feel uncertain whether you will ever be able to experiment with these new elements of the sub-Daltonian atoms, or Daltonian substratum of matter without atoms; or whether we have passed out of the region of that more occult chemistry in cooling down, or whether we are moving towards it, and, in the condition of mercury, shall attain it.

At any rate, I trust that in discussion chemists will remember to distinguish between the Daltonian atom of our chemistry and that of the mind bewildered with the incomprehensible idea of infinity. I do not enter on other proofs of atoms from the laws of gases, &c., &c.; I wish only to attempt to make an arrangement in discussing the Daltonian chemistry, and advise chemists to be careful in throwing aside opinions until they have better reasons than any given. The President of the British Association did good service by bringing forward the subject as I think.

Such ideas I have often spoken of, and you will not require me, I hope, to sign my name, as I have no time for discussion at present, and I can escape it better by writing simply as an

ATOM.

November 20, 1873.

DIDYMIUM IN SCHEELITE.

By CHARLES HORNER.

SCHEELITE from some localities, I find, contains didymium, notably the specimens from Traverella, Piedmont,—plates of 2 m.m. thickness showing the characteristic group of lines at D to great advantage. Although the lines are very distinct, yet the amount of this element must be exceedingly small, since a borax bead saturated with the finely-powdered mineral failed, in a vitreous condition, to show even a trace when examined by the spectroscope. However, after allowing the bead to cool, and then gently re-heating it according to the plan adopted by Mr. Sorby, the didymium crystallised out, showing the spectrum to perfection.

I have observed didymium in Cumberland scheelite, but it appears to be absent from some American specimens.

Fern Villa, Mortlake,
Nov. 18, 1873.

ESTIMATION OF CARBON IN PIG-IRON.

By GEORGE S. PACKER.

THE following method for the estimation of carbon in pig-iron, and having reference to a paper by Mr. C. H. Piesse (CHEMICAL NEWS, vol. xxviii., p. 198) on the same subject, may be of interest to some of your numerous readers:—

2.5 grms. of pig are treated with 50 to 60 c.c. of CuSO_4 (1:5), and, after standing 7 to 8 minutes in the cold, the solution is gently warmed, until the pig is completely decomposed; there is then added 20 to 25 c.c. of CuCl_2 (1:2) and 50 c.c. of (pure) strong HCl , and the solution is gradually brought to boiling; by this time the precipitated copper should be re-dissolved (time, 45 to 50 minutes); it is then filtered through an asbestos filter, made as follows:—

The usual asbestos funnel—a tube about 8" long and 1" diameter, drawn out at one end to a neck about 1" diameter—has some pieces of very thin glass rod, about 1" long, placed side by side firmly in the narrow end, and above these some previously ignited asbestos, loosely plugged, about 1" thick layer; some hot water is then run down the funnel to consolidate the asbestos, and the solution is then filtered and washed in the usual way.

This filtration and washing can be done in 5 to 7 minutes, unless the pig be very siliceous, when it sometimes takes 20 to 30 minutes; if the solution be allowed to boil for some time, or even stand (over-night, for instance), the Si forms gelatinous SiO_2 , which greatly hinders filtration. The asbestos and carbon are now placed in a 200-c.c. flask with 3 grms. C_2O_3 , using as little water as possible for rinsing in; the flask is fitted with a 2-oz. stopcock funnel and delivery-tube to conduct the gas first through a U-tube containing some H_2SO_4 only (I find a wash-bottle and H_2SO_4 allows the acid to run back if a draught should blow the light under the flask a little on one side for an instant), and then through one containing broken glass and H_2SO_4 , and then into potash-bulbs. The funnel is filled with strong H_2SO_4 (40 c.c.), and, when the connections are all made, the acid is allowed to flow slowly in; the solution is gradually brought to boiling, and kept so a minute or two, till all evolution of gas ceases; air is then drawn through the apparatus, allowing it first to pass through potash solution to absorb atmospheric CO_2 , and the bulbs weighed. Time, 15 to 24 hours.

This method is a modification of that of A. H. Elliott, given in the last edition of "Fresenius" (by A. Vacher). I have described it rather fully for the sake of any who may not have easy access to the above-named edition.

My intention in writing this has been to call attention to the method, which gives very con-ordant results, and can be executed with great rapidity. I have repeatedly done a determination, including all the necessary weighings, in 24 to 24 hours. In the case of steels, or in pigs where the drillings cannot be obtained so fine, of course the

solution in CuSO_4 takes longer; and in steels, where a larger quantity must be taken for analysis, the reagents must, of course, be proportionately increased.

Hallside Steel Works, Glasgow,
Nov. 21, 1873.

COMMUNICATION FROM THE LABORATORY OF CHARING CROSS HOSPITAL.

By T. BOLAS.

On the Estimation of Oxidised Nitrogen in Potable Waters by means of the Ferrous Sulphate Test.

In testing for nitric acid as already described (CHEMICAL NEWS, vol. xviii., p. 249) it is quite possible to float the aqueous liquor on the vitriolic fluid with such steadiness as to cause the surface of the latter to assume the form of a sharply-defined meniscus. In this case it is necessary to give a slight rotatory motion to the vessel containing the test in order to produce the small amount of heat which is required for the production of the dark compound. The formation of a meniscus should always be aimed at, as a much greater intensity of colour is attained when the meniscus is produced, and subsequently destroyed by careful rotation, than when the aqueous liquid is added in such a way as to cause a sensible amount of agitation. When the "nitric acid test" is employed, the dark tint appears in the vitriolic stratum, and not, as when the ordinary method is used, in the aqueous stratum; and, moreover, if the rotation be continued, the upper portion of the vitriolic stratum remains coloured to the last, even if the aqueous liquid has become hot enough to instantly decompose the dark compound.

Under any circumstances, the quantitative indications obtained in this way are, as previously pointed out, somewhat vague. This arises, to some extent, from the difficulty of producing equal temperatures in both tubes. The delicacy of the test, when performed as now recommended, is fully equal to that attained in the usual way, 1 part of oxidised nitrogen in 25,000 being recognisable in either case. When, however, the operation of testing is conducted in such a manner as to produce the dark tint throughout the whole mass of the liquid, the delicacy of the reaction is increased four-hundred-fold, and 1 part of oxidised nitrogen in 10,000,000 parts of water becomes capable of recognition; and, moreover, the tints thus produced are well adapted for the colorimetric determination of small quantities of oxidised nitrogen.

The colorimetric comparison is best made by mixing the water to be examined with its own volume of pure sulphuric acid; and, after cooling, 80 to 85 c.c. of the mixture are placed in a tall jar, 15 to 20 c.c. of the nitric acid test being then added, and under these circumstances the heat produced is sufficient for the formation of the compound $2(\text{FeSO}_4)_3\text{N}_2\text{O}_2$, but it is not sufficient to destroy this compound. These proportions are suitable when the temperature of the materials is 14° to 17°C. , and a rise of about 10° takes place on mixing. Having thus produced the brown tint in the test, a mixture of vitriol with an equal volume of a standard solution of nitre is similarly treated, and the tints of test and standard are compared. If the standard is rather darker than the test, a portion of the former may be removed in order to make the intensity of colour equal in both jars, and, of course, the portion removed must be considered in calculating the results. Similarly, a portion of the test may be removed if its tint is slightly darker than that of the standard.

When jars containing a large proportion of nitrates are being examined, it is advisable to use smaller jars than those required for 100 c.c. of liquid, and it is scarcely necessary to remark that evaporation must be resorted to when the proportion of nitro en is smaller than 1 in 10,000,000. If the water contain organic matter which blackens under the influence of vitriol, or if it is naturally dark in colour, it must be distilled, with the addition of

about one-fourth of its volume of sulphuric acid, and the distillate, which should be equal in amount to the water taken, must be treated as described above.

In preparing the nitric acid test, it is better to use pure oil of vitriol than the commercial article, as in this case the application of heat is not required. Although a solution of ferrous sulphate containing far less of the salt than the amount required for saturation may be used in the preparation of the nitric acid test, it is advantageous to prepare it according to the directions already given, and to allow the deposited crystalline salt to remain at the bottom of the stock-bottle, the separating salt acting to some extent as a decolorant.

In order to avoid an undue consumption of vitriol in making comparisons, I intend to try how far discs of glass, either coloured, or covered with a coloured varnish, may be substituted for the standard solutions.

Charing Cross Hospital,
Nov. 18, 1873.

ON HEAT.*

By FREDERICK GUTHRIE, B.A., F.R.S., &c.

THE "Sources of Heat" and "Expansion" were treated of as follows:—

In considering what we may call the laws of any physical force, we are necessarily led some time or other to study the way in which the force affects ourselves. In fact, the only inlet is through our various organs; but in all, or most cases, it is necessary, before studying this, to get some notion of the objective relations of the phenomena themselves. The eye is generally the organ which is selected for final accurate measurements. Although we may appreciate sound through the ear, yet we may feel the body throb with our hands even. We may distinguish between pitch by the ear, but for accurate measurements we refer to the eye. Measuring wavelength is a thing chiefly of vision, partly of touch, but not of hearing, taste, or smell. So, in considering heat, we shall soon find ourselves compelled to come to the eye. With regard to the sensation of heat, of course you usually understand that it can never furnish an accurate measure of temperature. The sensation of heat appeals to the same nerves as the sensation of touch, but the body itself has a certain temperature, and what you really feel as the sensation of temperature derived from touch is not a direct appreciation of temperature at all. But it is an appreciation of loss or gain of heat in those liquids surrounding the nerves of touch, and whereas for the other forces, such as sight and sound, taste and smell, bundles of nerves are employed, almost all parts of the body are sensitive to heat. The different nerves are differently sensitive to heat as to touch; but the same nerves which take up the sensation of touch take up the sensation of change of temperature—the loss and gain of heat being what we appreciate by plunging our hands into hot or cold water. This gives rise to the terms hot and cold. My hand loses heat in cold water, and I have the sensation of cold, whereas another person, whose hand is warmer, may feel hot.

So, at starting, we are obliged to abandon the cutaneous sensation of hot or cold as a measure of temperature. It is simply a measurement of our own sensitiveness and the temperature of the blood at the time. We must therefore return to certain physical effects which will be referred to the eye as the measuring organ. Perhaps the most conspicuous physical effect is that of expansion, or the property which heat has of increasing the lengths of bodies.

Roughly speaking, we may lay down the rule that all bodies expand by heat; that is, if we take a cubic inch of matter, on heating it becomes a cubic inch and

* Abstract of the first of a course of Lectures to Working Men, delivered in the South Kensington Museum on Monday, the 17th ult.

something more, expanding in all directions. If we take a linear yard of matter, that yard expands the same fraction of its thickness in all directions as it does of its length. In this way, by taking a thin and long rod or wire of matter, I may exaggerate expansion and render it palpable.

A platinum wire is made red-hot by passing a current of electricity through it. One end of the wire is rigidly fixed to an upright rod, while it is kept stretched by a weight at the other end. This weight is in communication with an index, which shows the lengthening of the wire on heating and its constriction on cooling. The same effect may be shown by a copper sphere which passes through a cold ring of brass; but the ball, heated for a few seconds, expands, and refuse to pass through until it cools to the temperature it was before, or rather till the ring and the sphere reassume the same temperature, both higher than to begin with.

One may also appeal to the sense of hearing, in order to prove the expansion of solids by heat. A rocker of copper is placed upon a bar of lead and heated, but no action ensues. If the rocker be tipped on one side, however, it causes a little mountain of lead to be formed, which tilts over the copper just as in shuffling the shoulders. This takes place so rapidly—more than sixteen times in a second—that one hears the successive blows of the copper on the lead. They produce a musical note, just as all rapidly succeeding sounds do.

All these experiments have been to show the expansion of solids, sometimes appealing to the eye, sometimes to the sense of hearing. Now let us see that liquids expand when they get hot; after that we will take the third form of matter—gaseous, and show that gases expand also.

Let us take, as three typical liquids, water, alcohol, and mercury. Surround these with hot water; and, as solids expand by heat, the first effect of this hot water will be to heat the glass and increase its capacity; just as the hole of the ring increased. The level of the water sinks because the same quantity has to fill a greater capacity; but the glass does not expand so much as the water, hence the expansion of the water prevails over the expansion of the glass, and the level of the water rises. Alcohol and mercury behave in a similar manner.

In the same way, let us take an example of the most familiar gas of all, or a mixture of gases—atmospheric air. That air expands when heated is illustrated by many toys, the balloon depending on the fact that heated air is lighter than cold. We have, say, a cubic yard of air; expand that, and it still has the same weight when expanded as it had when cold; but take a cubic yard of that expanded air, and the weight is evidently less.

Coming from toys to scientific instruments, we have here a means by which atmospheric temperature can be measured. The differential thermometer, so-called because it shows when the one bulb is heated more than the other, and not that one place is warmer than another, is composed of two bulbs connected by a glass tube twice bent at right angles. The air expanded by heat forces a liquid or an index towards the other bulb, and thus variation in temperature is communicated.

Having seen that solids, liquids, and gases expand by heat, let us pursue the subject further, and see the expansion which different solids undergo by heat.

If I surround a brass rod with ice-cold water, then with boiling water, marking the expansion, afterwards expose a similar rod of iron to the same conditions, there would be a difference of expansion between the two metals. The expansion of different metals are measured roughly in this way.

That solids expand differently for the same temperature may be shown by a bar of iron riveted to a bar of brass. The bar of iron below receives the heat first, and expands, and the bar bulges out towards the iron; but iron does not expand so much as brass for the same increase of temperature; hence, when the heat has penetrated through the iron to the brass, the brass assumes the form of the arch

to gratify the relative expansion of the two metals. Another means of showing the same effect is by a compound ribbon of platinum and silver in a spiral form. On the application of heat the spiral unwinds, because of the expansion of the inner coil of silver, and on cooling it is reversed. Attached to an index on a dial, this is used as an atmospheric thermometer. We have established the point that solids expand unequally for the same increase of temperature, and this inequality also prevails with liquids.

We will experiment with three equally filled flasks of water, alcohol, and mercury, all heated to the same temperature. The difference in expansion is seen in the different level of the various liquids.

In the case of gases, no such inequality of expansion exists, as different gases expand to the same fraction of their volume when heated through the same range of temperature.

ON THE ENERGIES OF THE IMPONDERABLES, WITH ESPECIAL REFERENCE TO THE MEASUREMENT AND UTILISATION OF THEM.*

By the Rev. ARTHUR RIGG, M.A.

(Continued from page 273).

LECTURE VI.

The Energy of Light, especially with reference to the Measurement and Utilisation of it.

THE energy of light is all-pervading. Wherever life is, there this energy is. Darkness, or absence of light, is another name for death. That our knowledge of the mode in which this energy acts is "cabined, cribbed, confined," there can be no doubt. It has, however, an extended influence; indeed, there is reason to infer that it has an actual active kinetic power which may be described as enormous, even when separated from its usual allies, heat and actinism. The very small area of explored light-land only serves to assure us by its embarrassment of rich energies that in respect to light there are not only as great, but even greater developments to be made, than have yet taken place in any of the "imponderables."

The animal, vegetable, and mineral kingdoms; solid, liquid, and gaseous matter, each, in some form or other, admits of the energetic action of what passes under the general name of light. Such universal consent to the power of light, which recent science investigations seem now, for the first time in the history of the human race, to be making known, is rendering a spontaneous but somewhat unconscious and undesigned testimony to the truths of Scripture. In the first chapter of the book of Genesis, and at the third verse, we read that the very first act of creation is light—"Let there be light." It must be admitted as singular, very singular indeed, that that old book—the Bible—about which some men civil, should have had written in it of events occurring, say, 6000 years ago (six million years ago, if you please), that which science-investigation of the last 50 or 100 years has only made clear to all who read. Strange that this, "offspring of Heaven first born," without which no life can even now be sustained in healthy vigour, should have been formed in the fulness of energy before revelation asserts that life was. The strangeness ceases when the religious faith in inspiration enters.

Before this lecture is closed the conclusions and illustrations, if successful, will prove that, whilst this energy is less comprehended, and, if possible, more perplexingly mysterious than even the energy of affinity, it is nevertheless one whose presence is for vigorous action. Even the conducting power of bodies for electricity have within the last few months been shown to be so connected as to be influenced by light.

It is not in my power to produce the experiment, but it may be stated that if a small bar of selenium—say two inches long, and one-eighth of an inch diameter—have

* The Cantor Lectures, delivered before the Society of Arts.

its ends electrically connected with such a galvanometer as you saw last week, then the speck moves as light shines upon or is excluded from the bar.

The sources of this energy are the sun, the stars, and meteors which, in some way unknown to us, setting aside the theory of luminous heat consequent upon atmospheric friction, are self-luminous.

There is no similar self-luminosity on earth. If it be wished to obtain light from other and accessible sources it is done by extraneous agencies. Heat caused either by affinity, electricity, or mechanical means, or by a concentration of the energies of some self-luminous source, is the way by which we usually produce light.

This process of production by concentration from self-luminous sources, although generally adopted, is very unpromising as a means for ascertaining the energies of such source-produced light. For this reason—as the light passes through or is reflected from the bodies employed in the concentrating operation, the extent or degree in which this energy may have been expended in chemical or physical work within or upon the concentrating body cannot be ascertained. Hence the remaining work—be it represented chemically or mechanically—is all that is left for investigation. It represents but the balance of the account. Now, as a coin so small as one shilling may represent the balance of two accounts, neither of which reaches one pound, so the same coin may represent a balance of accounts reaching many thousand pounds. Clearly, then, from this remaining work no inference can be drawn respecting the total of the energies involved in the production of such a balance.

The energy of light varies with the source from which it originates. In some respects, viz., as regards heat and light, properly so called, the energetic elements in what we call the electric light are more similar to those in the sun than any from other lights within our means of artificial production; in another respect, viz., chemism, or adinism, the energy of that from the combustion of magnesium is nearer to solar light than is the electric.

There are two lights which seem to have in themselves no traces of an energy producing effects on any of our appliances. They are the result of some unknown and as yet unappreciated energy. These are lights due to phosphorescence and fluorescence.

The decay of what was once possessed of the energy of vitality is a condition manifesting phosphorescence, a state in which light is without much (if any) heat. Whether the light on being given out is the result of some new operation of what was once called the vital principle, or whether it is a consequence of some elements of affinity approximating in character to those we call combustion, is an unsolved problem. Friction, also the passage from a formless state to the state of crystal, frequently causes a phosphorescent light to be emitted.

Phosphorescence is a name also given to a mode of obtaining light which seems to depend upon the property that certain bodies possess of rapidly concentrating within themselves the light they may receive from being exposed in the neighbourhood of a luminous body, and then emitting this absorbed light gradually. Probably the light stored up in a few seconds is not emitted in less than minutes.

Diamonds and other substance shine in the dark for a short time, after exposure to intense light. This shining of certain crystals, in the absence of light, probably led to the opinion that such crystals were living beings, petrified by light in the hands of men. Certain flowers, especially those with bright yellow petals, sometimes emit a sudden flashing light a little after sunset; also, some plants growing in mines emit light from their whole surface. Certain preparations continue to emit this light so intensely and continuously as to be used as night-lights—not for illuminating rooms, but for such purposes as reading the hands of a watch.

There are in this box a series of tubes which, doubtless, appear to all of you, at the present time, perfectly

white. If, however, we allow an intense light to shine upon them, they are seen to possess a phosphorescence that will last some time—from ten minutes to half-an-hour, as the case may be. This magnesium lamp shall be lighted, and the tubes exposed to its rays for a short time, and you will see, not only the simple phosphorescence, but different colours which the contents of each tube assume.

Fluorescence is a peculiar appearance consequent upon placing some substances in certain position with respect to light. This may be illustrated by the action of light upon sulphate of quinine. In this bottle is what appears as pure colourless water; it is a very weak solution of sulphate of quinine. If looked at in the presence of light rich in actinic rays, a change in the appearance is observed. A piece of magnesium ribbon is now lighted. In certain angular positions a beautiful azure blue may be noticed; this blue is a consequence of those phenomena called fluorescent. These, phosphorescence and fluorescence, are two characteristics of the energy of light, of which all we know is that we can render no account of the causes of them, unless the theoretical explanation be accepted that the two may be classed as one—by regarding them as consequences of an alteration in certain wave lengths in portions of the entire beam of light. From the previous statements it may be inferred that the measurements of the energies of light are not yet accomplished; also, that two lights, which to the eyes do not differ much in intensity, or in what some might call power, yet may show very different energies. It must be borne in mind that here, as in electricity, intensity is not energy; there may be great intensity and little energy.

The great source of light is the sun, and whatever may be the speculations of science, either as to the cause of that light, or as to the mode in which it is propagated from the sun and received at the earth, they do not concern us at present. What we are concerned with is, how are the energies of the light thus received, and of such artificial lights as are utilised, to be measured?

A reference to the diagram of the spectrum may explain what is manifested by an analysis of solar light. Observe, there is shown in this spectrum heat, light, and adinism, or chemism, as it is sometimes called. The spectrum visible to us is the part thereon coloured, containing the usual prismatic colours, red, orange, yellow, green, blue, indigo, and violet; therefore, the light, properly so called, and which is utilised by human eyes for vision, extends from the letter A to the letter H, and no further, and any energy consequent upon the state which occurs before the letter A, and any energy consequent upon the state beyond the letter H, is not the energy of light properly so called. Now, to our left of the letter A, extending over a space which bears a proportion to light, about half as long again as light, is a space containing the energy due to heat. To our right, beyond the letter H, extending to a distance longer than that of light, we have a space in which photographers and chemists delight. Chemists can get nothing out of this dark end to our left except heat, and chemists and photographers get nothing out of that dark end to our right except chemical action. The intensity of heat lies here, just before we reach light at all; and the intensity of chemical action lies there, just after we get beyond the light. No scientific investigation has yet detached the energy of light and its intensity from these two energies with which it is associated. At this line, marked D on the diagram, it will be noticed that those curves, indicating heat and adinism, die out. The one seems to be passing into the other. At D is what mathematicians might name a "cusp"—a zero on the scale similar to that zero in the arithmetical tables which may be said to mark the turn between counting by integers to the left, and by decimals to the right. At D is this dead blank for heat and adinism, and yet it is there the energy of light really lies. Before the end of the lecture something more

should be said about the energy of light at this particular point. Amongst these three constituents of a solar beam—heat, light, and adinism—there are several marked and extraordinary differences, yet we call them all “light.” For instance, heat causes bodies to expand, but heat fails to make an impression upon the retina. Professor Tyndall, some years ago, put his eye into the focus of a heat beam where platinum was melted, and it produced no impression upon the eye. In his account of the experiment he says he did it, but he does not advise anybody else to do it—a piece of advice likely to be more generally accepted than advice usually is. This shows that heat fails to make an impression upon the retina. Heat also fails to produce any photographic result; heat can be conducted along metals, and heat can cause organic and inorganic bodies to expand.

Light, properly so called, possesses these qualities. It makes an impression upon the retina, it effects changes in organic bodies, and probably (in some way mysterious to us) in inorganic bodies also. Light does not possess these qualities—it cannot be conducted by metals, it cannot cause bodies to expand. Now, as to adinism, or chemism, it possesses these qualities—it produces photographic results and chemical changes in organic as well as in inorganic bodies. It does not possess these qualities—it fails in making an impression on the retina, it cannot be conducted by metals, and it cannot cause bodies to expand. Hence there seem to be properties in each portion of the spectrum which do not exist in the other; therefore in the comprehensive term—light—there are three distinct elements, and it is really an error to write them under the one name light. Great would be the social misunderstandings if, because wheat, barley, and oats are all called corn, or grasses, these general terms were as constantly applied to them as the term light is to phenomena with which it is associated, but not connected.

There is also another form in which the energy of light is presented, *i.e.*, in its penetrative power.

For lamps and lighthouses this penetrative power is all important. Certain substances in combustion are possessed of this power in a much higher degree than other substances. It is not, however, only in the material burnt, but further in the mode of burning, that this penetrative power is manifested. The same substances under different conditions manifest very different energies in the emission of light to a distance.

Even the ordinary paraffin lamps—how very inferior in illuminating power some are to others. The utilisation of the energy in the one and only way in which it can be utilised without waste is well illustrated in the various constructions for the burning of different hydrocarbons, to which time forbids further reference. Many present are aware of the different schemes now before the public for obtaining both light and heat from the combustion of the hydrocarbons.

But it is not in liquids only that this difference exists. Even the same quantities of gas—*i.e.*, of a suitable gas—one containing such an element as carbon under different circumstances, yields lights of marvellously different penetrative power.

Here is a common gas-burner; if a short tube having a few holes at the bottom be placed over it and the gas lighted at the top of the tube, you have a light which has a certain non-penetrating power. It cannot penetrate far; it has a pale blue lambent flame. Now if the tube be taken off, and the gas lighted at the burner, you have the same quantity of material burning, but with a very different penetrating power. In this case it is evident that the penetrating power depends entirely on the mode in which the apparatus is arranged for combustion of the gas.

From the remarks made it may be inferred that science is yet incompetent to pronounce decidedly, 1st, what or which element or elements in the solar beam constitute light properly so called; and, even if this be deter-

mined positively, yet science is still undecided by what rule, or weight, or measure, the energy of light is to be gauged.

Indeed this remark may not be an exaggeration—in all probability no two persons see the same degree of light. It may be surmised that no two persons see any portion of this spectrum of the same colour, and, further, it is highly probable that there is no such thing as colour in nature at all. It is likely that colour is a pure impression produced upon the retina of each person's eye by the vibrations of the medium which strike upon it. Hence what we call red, orange, yellow, green, blue, indigo, and violet do not exist actually on the spectrum, but in the eye of the observer, and probably one person will see the red beginning here, and extending thus far, whilst others will see it beginning a little more to the left, and ending a little more to the right, or *vice versa*. Upon that point there is nothing really settled.

As to the first of the foregoing inferences the energy of light is said to be concentrated in the yellow portion of the visible spectrum. If the views of those whose pursuits are photographic are to be received, the perplexities of science are increased. The very name of their art—photography—indicates the writing of or by light alone.

The fact is that photography is not a process dependent upon light as light, but upon that portion of light which is possessed of certain peculiar and hitherto unexplainable influences of a chemical character. Photographic chemistry is as yet very partially understood—we are it not that those who think they understand it might be offended, the truth would not be outraged by saying that photographic chemistry is not at all understood. And yet no process for estimating the energy of light, as light, has been suggested more hopeful for success than that dependent upon chemical changes; but these are not those chemical ones to which the photographer appeals. The fact is, that those changes appreciated by the photographer can be produced in inorganic compounds; what they are can be partially noted, they can be recorded, and that in terms which are but relative (not absolute), and which chemistry alone can measure. The day may not be distant when the energy of light, as light, will be duly and absolutely measured.

Judging from its place in the order of creation—previously named—judging from its influence over the whole world of animal and vegetable existences—judging from such facts as that when light is absent all animal and vegetable life lapses into a species of torpor, or sleep, and on the return of light nature awakes, and resumes its activity and strength, the conclusion is a very legitimate one, that in light—as light—there is great energy. Light opens the eyes, not of animals only, but even of flowers; hence one of our little English flowers is called “The day's eye.” Those who can sleep through noise, and even through heat, are not insensible to the energy of even artificial sources of light playing, however gently, upon the closed eyelid. Medical men and nurses are well aware how essential light is for the regaining of health and strength by the sick or the infirm. Egypt and Madeira, as sanatoria or convalescent homes for our ailing brothers and sisters, may owe more of their influence to qualities or energies of light very different from those the photographer esteems than are usually allotted to them. And it may be permitted to add that marvellous testimony to some unknown element (be it figurative or be it real) which, whilst pervading all Scripture from Genesis to Revelations, assumes a most marked peculiarity in that expression of St. Paul (Eph. v. 14), “Awake thou that sleepest, and arise from the dead, and Christ shall give thee [marvellous gift] light” not life, observe, but “light.”

(To be continued.)

* This subject has been examined more in detail in “The Harmony of the Bible with Experimental Physical Science,” published by Bell and Daldy, price 2s. 6d.

CORRESPONDENCE.

ALUM IN BREAD.

To the Editor of the Chemical News.

SIR,—“Og” in his letter (CHEMICAL NEWS, vol. xxviii., p. 262) asks for an explanation of the “Shoreditch case.” The commentators have so unceremoniously adopted the misleading statements made at the Shoreditch meeting of master bakers, excepting in the case of the *Times*, that one can only deplore their readiness to arrive at anything sensational by any means, and learn that truth is not always sought after. You intimate your intention of publishing an article on the subject; prior to your so doing, allow me to request you will read the enclosed copy of a letter sent to my Directors, who asked me for the full particulars of the case. It is curious to observe how, in hurried exercise of judgment, even technical journalists are capable of publishing most gross mistakes. One of these (*Iron*), in commenting on adulterations, observes that a chemist in seeking for sulphuric acid pursued a course that would effectually destroy it, alluding, I have no doubt, to a published statement of mine that “the bread was burnt in a platinum vessel, and the ash carefully examined for alumina, &c.” This reporter or editor, in his wisdom, conceived, I suppose, that the sulphuric acid must be decomposed and lost, whereas the ash when oxidised should have yielded satisfactory evidence both of the presence of alumina and sulphuric acid, unless ammonium-alum had been employed; even then the water-solution or extract should have given evidence of H_2SO_4 . In the Shoreditch case, the test failed to detect the constituents of alum (in any appreciable quantity) said to be introduced as an adulterant, and the question put to me was to determine whether it was “bad bread adulterated with alum,” which charge it was certainly free from.

There has been so much misrepresentation that I gladly take this opportunity of placing the facts before you, that you may know what actually occurred and what course was pursued.—I am, &c.,

E. V. GARDNER, F.A.S., M.S.A.,
Professor of Chemistry.

Royal Polytechnic Institution,
Nov. 25, 1873.

IRON FILINGS IN TEA.

To the Editor of the Chemical News.

SIR,—Mr. Alfred H. Allen (CHEMICAL NEWS, vol. xxviii., p. 275) says that he has found “genuine iron filings” and “real lumps of iron in tea.” As the subject is of considerable practical interest, and Mr. Allen’s testimony is of unquestionable value, I venture to ask him two questions—(1) Were these found in the ash or in the unburnt tea? and (2) How did he determine that the particles of iron were genuine filings, and what was the quantity of these and the lumps?

As regards the supply of iron filings, Mr. Allen says that he has no doubt that he could beg a hundredweight of finely divided iron to-morrow. My Sheffield experience, to which Mr. Allen refers, satisfies me that he is quite right, but would it be so easy to “beg” such refuse if it were systematically used for the adulteration of tea,—if there existed a market for anything like the quantity that I have shown would be required? It is just because they are not used for any such purpose that the various kinds of iron dust produced in Sheffield are so worthless. If there were a demand for the large quantity (5,000,000 lbs. per annum) that would be required for the alleged adulteration, all the iron-works of the world would, as I have already stated, be attacked by collectors of the material, and Sheffield—being capable of producing more than any other place in the world, probably more than could be produced throughout the whole of the Chinese Empire—would be thus attacked the most vigorously, and Sheffield

iron dust would be worth as much as Sheffield armour-plates, and quite as difficult to “beg.” If this adulteration were carried on at home, as Mr. Allen supposes, both he and I would have seen or heard of truck-loads of iron dust being loaded up on the sidings of the Sheffield railways and forwarded to London, which is the wholesale tea-mart of Britain.

While differing with Mr. Allen on this subject of iron filings, I take this opportunity of expressing my admiration of the manner in which he, Mr. Wanklyn, and Mr. Bird have studied the subject. The working of the Adulteration Act has strikingly displayed one of the most important influences of scientific education. The exceptional few of competent chemists who have had the courage to accept the post of public analyst have distinguished themselves by the modesty of their certificates; they have fairly measured the difficulties to which Mr. Allen has referred; and we might almost affirm that the amount of adulteration detected by the different public analysts has varied inversely with the amount of their chemical knowledge and analytical skill. The best chemists have, doubtless, best understood that their office demands a special technical skill, for which the education and experience obtainable in our ordinary chemical laboratories only affords the preliminary, though necessary, scientific basis, and that further and special preparation is necessary in order to qualify even the ablest of our chemists to fulfil satisfactorily the duties demanded by the Adulteration Act.

This is well illustrated by your article in last week’s number of the CHEMICAL NEWS, on “Alum in Bread.” Such difficulties as are there explained, and the confiding evidence obtained in every prosecution where the shop-keeper has been able to afford the cost of obtaining further analyses than those of the public analyst, have proved the cruelty and injustice of the hasty and ruinous convictions that were based upon the half-crown analyses and superficial certificates in the early prosecutions under the new Act of Parliament, and enforce the necessity of the utmost caution in the meantime, until practical and special experience has enabled the public analyst to master the difficulties of his newly-created business.—I am, &c.,

W. MATTIEU WILLIAMS.

PS.—Since the above was written, I have read the able summary of the Birmingham tea cases by Mr. Kinnersley, the Stipendiary Magistrate of Birmingham. It is fully reported in the *Grocier* of Nov. 29, and I recommend it to the perusal of your readers interested in this subject. It appears from this that further experiments have induced Dr. Hassall to reconsider his former conclusions; he has just written to state that he now concludes “that the iron detected in the tea was not really iron filings, but magnetic oxide and crushed ore.” This is a strong confirmation of my theory of the origin of the iron that has been detected in tea.

PUBLIC ANALYSTS.

To the Editor of the Chemical News.

SIR,—Will you kindly allow me space for a few remarks on the subject which called for your leader in the CHEMICAL NEWS of last week? I thoroughly agree with the remarks you then made, and I only think that they did not go far enough. The subject of the competence of the public analysts appointed under the Adulteration Act is a very important one, both from a social and from a scientific point of view; and I think I may safely say that the growing distrust of the public as to the value of the act itself, and particularly as to its administration, is more than proportionally shared by members of the chemical profession generally, and who are not personally interested in carrying out the Act, but who look on from outside as impartial critics.

The adulteration question seems to oscillate, in the public regard, between two “poles,” if I may use the

similar—the “positive” one of panic, and the “negative” one of indifference—both extremes being mischievous, but that one of panic being by far the most hurtful. Adulteration panics are often aided greatly in their development and progress by persons who, being ignorant of the subject on which they write, are therefore the more enthusiastic, or else by others who have some interest to serve by raising an agitation on the subject.

Much of the mischief arises from two very common abuses—viz., the appointment of incompetent men to the office of analyst, and to the plurality of appointments held by the same analyst. This latter often necessitates the employment of assistants, sometimes engaged at a low rate of remuneration, the only part of the duties performed by the public analyst himself (besides drawing his salary regularly) being the signing the certificates, and the assuming the responsibility of defending them if called in question in a court of law.

I, as a chemist, am glad to observe that most of the *fascios* hitherto made public have been the work of military officers of health, and not of regular professional chemists. When will people be disabused of the idea that, because a man may make a successful diagnosis of a medical case, he is, *ipso facto*, equally competent to perform a complex chemical analysis? These frequently occurring “mistakes” are calculated to lower the prestige of the analystship, not only in the estimation of the public, but, what is of much greater consequence, in that of the better part of the chemical profession. It is to be feared that all this will end in deterring competent chemists from accepting the office of public analyst, and will leave the vacancies to be filled by young and incompetent members of the profession, or by medical gentlemen, who, as a rule (with certainly a few bright exceptions), are generally unfitted, through want of proper training, to fill the office.

In the interest of society at large, and of the chemical profession itself, it is very desirable that the whole subject should be thoroughly discussed in its various aspects: and, in my opinion, there is no more suitable medium for doing so than the columns of your valuable journal, which, occupying as it does, the first position in English chemical periodical literature, is presumably read by all persons who may be supposed to be interested in this subject.

Seeing how small is the amount of information on “food analysis,” of any real practical value, at present available, there can be no doubt that a series of essays on the subject, appearing in the *CHEMICAL NEWS*, and written either by yourself or by some other competent authority, would be of very great value at the present time, and they would be highly appreciated by very many of your readers, myself among the number.—I am, &c.,

WILLIAM RATCLIFFE.

Wolverhampton, Dec. 2, 1873.

[Such a series of essays is in preparation, and will shortly commence.—Ed. C. N.]

ON THE COEFFICIENT OF EXPANSION OF CARBON DISULPHIDE.

To the Editor of the *Chemical News*.

SIR,—In your report of the meeting of the Chemical Society last week, you represent Professor Foster as saying that there must be an error in my calculations. I am sorry to say that he is perfectly correct; I have inadvertently introduced an error into the formula for calculating the expansion. I make this avowal to prevent any scientific man from being misled by the figures given in your report, but the corrected numbers will be given when the paper is published in the Society's *Journal*. The only excuse I can offer is that I was attempting to do too much, and, when persons have too much business and brain-work all day, they generally find their heads are never so clear at night for calculations.—I am, &c.,

J. B. HANNA.

Dec 1 1873.

EVOLUTION AS APPLIED TO THE CHEMICAL ELEMENTS.

To the Editor of the *Chemical News*.

SIR,—In the issue of *Nature* for Nov. 6, Mr. Blanshard has drawn attention to the above subject by a letter, in which he pre-supposes that this theory has not been discussed before.

Allow me to refer him to a letter by the writer, published in your journal (vol. xxiv., p. 131), in which a parallel was drawn between the derivation of the endless variety of plants and animals from one or more simple forms, and the integration of all the so-called chemical elements and compounds from one primordial matter.

Again (vol. xxvi., p. 138), a paper was published by me, on the “Constitution of Matter,” in which I sketched some of the considerations leading to the conclusion that from one primordial matter have been developed or evolved all those integrant parts the study of which constitutes the science of chemistry. To substantiate such views it is chiefly necessary to prove the identity of the matter of one element with that of all other elements, and this can best be done, perhaps, by showing that those properties, considered as peculiar to each element respectively, are properties which are determined by a definite expense of force in each case.

I do not wish to engage in any discussion on the matter, but perhaps I may be excused for pointing out that the above views seem to be gaining credit. Thus, at the meeting of the Chemical Society on May 15 last, Dr. Armstrong pointed out that “isomerism” admits of an easy explanation, if it be assumed “that different amounts of force have been expended in the formation of the isomeric compounds,” and, as Dr. Mills then stated, it was eight years since he had propounded and published a dynamical theory in explanation of “isomerism”—a theory “parallel to that proposed by Dr. Armstrong. The connection between such views and the evolution of the elements is at once evident.—I am, &c.,

CHAS. T. KINGZETT.

Kensington, W., Nov. 25, 1873.

PHOSPHORUS A TEST FOR IODATES.

To the Editor of the *Chemical News*.

SIR,—I observe in your “Chemical Notices from Foreign Sources” of Nov. 21 a notice of phosphorus as a reagent for iodates. Without wishing in any way to detract from the author's merit as being the first to publish this reaction, I may yet be permitted to state that I became acquainted with it more than eighteen months ago, while experimenting on the presence of iodate of calcium in sea-water. I made many experiments on the action of phosphorus on the iodates, one of which I find mentioned in my note-book, under date May 3, 1872, and as this particular experiment, referring to the action of red phosphorus, has still a shade of novelty, I give it:—“Red phosphorus diffused in water acts, especially when heated, upon iodate of calcium, liberating iodine. The phosphorus, added in excess, with addition of hydrochloric acid, gives a clear colourless liquid.” I enclose the leaf, torn from my note-book, containing this account. I used carbonic disulphide, containing a minute proportion of phosphorus dissolved in it, as a confirmatory test for the presence of an iodate in sea-water. But the experiment requires great care in order to get a satisfactory result; for, if the phosphorus is in excess, the carbonic disulphide (containing phosphorus in solution), when shaken up with sea-water, becomes opaque and of a brownish or violet tint, owing to the reduction of some traces of metals from sea-water, which, being collected by the disulphide, give that appearance. With proper care it is, however, possible to get the veritable iodine reaction from sea-water by this test; but the danger of the confounding of the true and the simulated reaction by some who might repeat my experiments without sufficient care,

debarred me from publishing the fact, especially as I gave adequate evidence of the presence of iodate in sea-water without it. Moreover, I intended to make further investigations as to the metals in sea-water which give the reaction referred to, and I have not yet been able to complete these. Hence the delay in publishing the observation I made as to the action of phosphorus on iodates.—I am, &c.,

E. SONSTADT.

Ramsay, Isle of Man, Nov. 24, 1873.

HYDROGEN AND SOLUTION OF NITRATE OF SILVER.

To the Editor of the Chemical News.

SIR,—Dr. Williamson's assertion that the solubility of hydrogen in water diminishes with rise of temperature, will probably surprise those of your readers who happen to have read Bunsen's admirable text-book on gas-analysis.

According to Bunsen, the solubility of hydrogen in water is the same for a wide range of temperature (the coefficient of solubility being 0.09). According to Bunsen hydrogen is distinguished from most other well-known gases by the constancy of this coefficient.

Whether Dr. Williamson's remark touching the solubility of hydrogen was made at random, or whether it was a record of unpublished experiments of his own, I am unable to determine. Dr. Williamson's statement that hydrogen is more soluble in solution of nitrate of silver than in water; and his suggestion that some chemist should make a measurement of the solubility of hydrogen in nitrate of silver, during the interval between the commencement of the passage of gas through the liquid and the first appearance of precipitation, calls for comment. It will be evident that, on the assumption that the first action of hydrogen is to reduce nitrate to nitrite of silver, the resulting nitrite cannot make its appearance until sufficient nitrite has been formed to saturate the solution. The experimenter who overlooks this fact will be in danger of calculating the hydrogen which has combined with oxygen as if it were existing in solution in the nitrate of silver.

For my own part I am inclined to doubt whether solution of nitrate of silver dissolves more hydrogen than water does; and I should advise caution on the part of any young chemist who is disposed to follow Dr. Williamson in this matter.

J. ALFRED WANKLYN.

Dec. 1, 1873.

MISCELLANEOUS.

The Royal Society.—At the annual meeting of the Royal Society, held at Burlington House on December 1, the following gentlemen were appointed officers and council for the ensuing year:—*President*—Joseph Dalton Hooker, C.B., M.D., D.C.L., LL.D.; *Treasurer*—William Spottiswoode, M.A., LL.D.; *Secretaries*—Prof. George Gabriel Stokes, M.A., D.C.L., LL.D.; Prof. Thomas Henry Huxley, LL.D.; *Foreign Secretary*—Prof. Alexander William Williamson, Ph.D.; *Other Members of the Council*—Sir George Biddell Airy, K.C.B., M.A.; Sir B. C. Brodie, Bart., M.A., D.C.L.; Professor Arthur Cayley, LL.D.; John Evans, Sec. G.S., F.S.A.; Daniel Hanbury, Treas. L.S.; Nevil Story Maskelyne, M.A.; Prof. James Clerk Maxwell, M.A.; C. Watkins Merrifield, P.R.S.N.A.; Joseph Prestwich, V.P.G.S.; Andrew Crombie Ramsay, LL.D.; Rear-Admiral G. H. Richards, C.B.; Prof. George Rolleston, M.D., M.A.; J. S. Burdon Sanderson, M.D.; William Sharpey, M.D., LL.D.; Francis Sibson, M.D.; Major-General R. Strachey, R.E., C.S.I. After the anniversary dinner, the Fellows of the Society adjourned to their new apartments at Burlington House.

Public Analyst.—Professor Alfred Anderson, Public Analyst to the Vestry of St. Martin-in-the-Fields, and Professor of Practical Chemistry in Queen's College, Birmingham, has been appointed Public Analyst to the Board of Works for the Poplar District.

Physical Society.—A preliminary meeting was held on Saturday last, in the Physical Laboratory of the Science Schools, South Kensington, to consider the formation of a Physical Society. The chair was taken by Dr. J. H. Gladstone, F.R.S. Thirty-six gentlemen were present, including most of the Physicists of London. It was resolved that the following gentlemen be requested to serve as an organising Committee:—W. G. Adams, E. Atkinson, W. Crookes, A. Dupré, G. C. Foster, J. H. Gladstone, T. M. Goodeve, F. Guthrie, O. Henrici, B. Leewy, Dr. Mills, A. W. Reinold, and H. Sprengel. A letter was read from the Lords of the Committee of Council on Education, granting the use of the Physical Laboratory and Apparatus at the Science Schools, South Kensington, for the purposes of the Society.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in utilising alkali waste in the manufacture or production of building materials. J. Buchanan, manufacturing chemist, Hebburn, Durham, March 1, 1873.—No. 752. The invention consists in combining the waste with sand, gravel, rock, slag, waste glass, ashes, or other similar materials. The combination is effected by grinding the materials together, and the compound is moulded into bricks or blocks or used as a cement.

Improvements in the manufacture of soda and potassa. James Hargreaves, chemist, Widnes, Lancashire, and T. Robinson, iron-founder, of the same place, March 3, 1873.—No. 764. This consists in heating a mixture of sulphate of soda or potassa with carbonaceous matter and metallic oxide or oxide to a point short of fusion. The mass is then cooled without exposure to the atmosphere and dissolved.

An improvement in dyeing and fixing of what are known as aniline colours. Edward Hunt, professional chemist, Worsley Street, Salford, Lancashire, March 3, 1873.—No. 766. This Provisional Specification describes dyeing and fixing aniline colours upon cotton and linen yarns and fabrics with a mordant composed of an aluminous salt combined with gelatin and tannin.

Improvements in treating catechu, cutch, or gambier, to obtain products therefrom suitable for use in tanning, dyeing, and printing. Edward Hunt, professional chemist, and George Manley Hopwood, both of Worsley Street, Salford, Lancashire, March 4, 1873.—No. 783. This provisional specification describes treating the catechu, cutch, or gambier so as to separate the material so treated into two products, the one suitable to the requirements of the tanner, and the other to the requirements of the dyer and printer.

Improved process for the extraction of iodine. Bristol Hunt, Serle Street, Lincoln's Inn, Middlesex. (A communication from Alvaro Francisco Carlos Reynoso, Paris.) March 5, 1873.—No. 799. This invention comprises the following processes:—(A.) Three processes for the extraction of the iodine contained in iodates, applicable to the extraction of the iodine contained in the mother waters, of the treatment of "caliche" in the mother waters, of the purification of American nitrates, and other similar products. (B.) Two processes for the extraction of the iodine contained in the form of iodide.

NOTES AND QUERIES.

Sulphide of Sodium in Black-Ash.—Would any reader please say what is the readiest method for estimating the above for manufacturing purposes where many samples are examined daily?—A SUSSEXMAN.

Vanadium in Iron Ores.—Can anyone inform me of a reliable method of estimating quantitatively the amount of vanadium in iron ores or pig-iron?—S. P.

TO CORRESPONDENTS.

ERRATUM.—In CHEMICAL NEWS, vol. xxviii., p. 277, col. 1, for "G. Bulik Francis," read "George Bulik Francis."

BOOKS RECEIVED.

Quantitative Chemical Analysis. By Dr. C. Remigius Fresenius, Sixth Edition; Translated by A. Vacher, J. A. Churchill. Elderhorst's Manual of Qualitative Blowpipe Analysis and Determinative Mineralogy. Edited by Henry Nasson, Ph.D., and Charles F. Chandler, Ph.D. Philadelphia and London: T. Ellwood Zell.

CHEMICAL TEXT-BOOKS.

Chemistry, Inorganic and Organic.

By C. L. BLOXAM, Professor of Chemistry in King's College, London. Second Edition, with 395 Engravings on Wood, 8vo., 16s.

By the same Author,

Laboratory Teaching; or, Progressive Exercises in Practical Chemistry. Second Edition, with 89 Engravings, crown 8vo., 5s. 6d.

Introduction to Inorganic Chemistry. By W. G. VALENTIN, F.C.S., Principal Demonstrator in the Science Training Schools. With 82 Engravings, 8vo., 6s. 6d.

By the same Author,

A Course of Qualitative Chemical ANALYSIS. With 19 Engravings, 8vo., 7s. 6d.

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Tables for the Qualitative Analysis of Simple and Compound Substances, both in the Dry and Wet Way. On indestructible paper, 8vo., 2s. 6d.

First Principles of Modern Chemistry. A Manual of Inorganic Chemistry for Students, Schools, and Science Classes. By U. J. KAY-SHUTTLEWORTH, M.P. Second Edition, crown 8vo., 4s. 6d.

Handbook of Volumetric Analysis; or, the Quantitative Estimation of Chemical Substances by Measure. By FRANCIS SUTTON, F.C.S., Norwich. Second Edition, with Engravings, 8vo., 12s.

Instruction in Chemical Analysis. By C. REMIGIUS FRESENIUS. Edited by ARTHUR VACHER.

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Fownes' Manual of Chemistry.

Edited by HENRY WATTS, B.A., F.R.S. Eleventh Edition, with Engravings and Coloured Plate, crown 8vo., 15s.

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SUPPLEMENT TO THE CHEMICAL NEWS.

VOL. XXVIII. No. 732.

THE EXAMINATION OF BLOOD-STAINS.

A COMMISSION, composed of MM. Mialhe, Mayet, Lefort, and Cornil, have furnished an interesting report on this subject (*Repertoire de Pharmacie*, July 10th, 1873; *Progrès Médical*, August 23). They point out that in the present day it is no longer possible, in the examination of blood-stains in legal medicine, to rest satisfied with the physical characters observed by the naked eye. The microscope, sometimes alone, but more often associated with chemical analysis and the spectroscope, enables us to obtain an exact diagnosis formerly impossible in a great number of cases. Two conditions may occur.

1. When the stain is of recent date, or supposed to be so, the red corpuscles should be particularly examined, and every care taken to preserve them without change. The stains must not be washed with water, so that the hæmatin may not be altered. After insisting on the microscopic characters of the blood-stains, isolated or compared with those of various animals, the commission enumerates with care the fluids which are destructive or preservative of blood-corpuscles. Among the first, water, and particularly hot water, acetic, gallic, hydrochloric, and sulphuric acids; and of alkalies, potash and soda, even in weak solution, and ether and chloroform, and many other reagents, so alter the blood-corpuscles as to cause them to entirely disappear. Alcohol, chromic and picric acids, and bichromate of potash, preserve the corpuscles, though they alter their form. The preservative fluids are those whose composition approach nearest to serum, such as the iodised serum of Schultz, an excellent preparation, made with ammoniac fluid, to which are added a few drops of the tincture of iodine, so as to give it the colour of white wine; or better, a fluid composed thus—white of egg, 30 grammes; distilled water, 270 grammes; and chloride of sodium, 40 grammes; or even a fluid containing 0.5 per cent of chloride of sodium, or 5 or 6 per cent of sulphate of soda. If the stains be wetted and softened by these fluids and then examined, white and red corpuscles and fibroid particles will be observed.

2. In more difficult cases, when the microscope, owing to the alterations which time has effected in the hæmatin, can give but vague information, examination by the spectroscope and chemical analysis enable us to arrive at precise results. The use of these means, being less known and also more delicate, requires special study.

1. *Spectrum Analysis*.—Colouring matters have the power of absorbing certain coloured rays of white light—the same always for the same substance. This is the principle on which spectroscopic examination is based. If into an analysing tube filled with water a few drops of a solution of hæmoglobin be introduced till it has the colour of peach-blossoms, the luminous rays of the spectrum passing through this fluid present two bands of absorption between the lines D and E of Fraunhofer in the yellow and the green. The same fact would be observed if a few drops of blood were substituted for hæmoglobin in the analysis. In a case of doubt, the hæmoglobin of the blood could be reduced by adding to this latter a reducing body. Destroyed hæmoglobin has a different spectrum from oxygenated hæmoglobin; a single absorption-band as large as the two former bands united, and a little to the left of Fraunhofer's line D.

2. In blood in a state of decomposition, or which has

been treated by acids or caustic alkalies, hæmoglobin is changed into a new substance; hæmatin is formed, which, combined with hydrochloric acid, gives characteristic crystals. In order to obtain them, we must proceed thus. A small fragment of dried blood is placed on a glass slide; it is dissolved in a drop of water, and a minute portion of sea-salt is added. It is covered with a thin slide, and pure acetic acid is made to pass between the two slides, and it is heated over a spirit-lamp to boiling-point. Acetic acid is again added, and it is heated afresh, and this is repeated till the crystals are obtained. They are rhomboidal, of a dirty brown colour, quite characteristic, and require to be seen with a magnifying power of three hundred or four hundred diameters. With the smallest quantity of blood these two reactions can always be produced—the spectrum examination and the crystals of hydrochlorate of hæmatin; and they are so certain, that the existence of one alone enables one to affirm the presence of blood.

3. The third process, though not so exact as the preceding, ought nevertheless not to be neglected. If to a very small quantity of blood dissolved in a little water be added a few drops of tincture of guaiacum and of biniodide of hydrogen, a persistent blue colour is immediately produced; but this very sensitive reaction can be obtained with other organic matter, nasal mucus, saliva, &c.; it therefore only gives a probability. We must proceed in the following manner. A tincture of guaiacum is prepared with alcohol at 83 degrees, and guaiacum resin; a mixture of sulphuric ether and biniodide of hydrogen is also made, and enclosed in a stoppered bottle, and kept under water in the dark. This preparation is less liable to change than pure oxygenated water. The object stained with blood, if it be white, is put into a little cup, then moistened with water to dissolve out the blood-stain, and washed in distilled water; this water is then submitted to the action of these reagents. If the thing stained be coloured, and the stain little or not at all visible, it must be moistened and then pressed between two or three sheets of white blotting-paper, and tried first with the guaiacum. If the stain be of blood, a reddish or brown spot will form on the paper. One of the sheets should be treated with ammonia, and the stain will become crimson or green. A second sheet, treated with tincture of guaiacum and ozonised ether, will give a blue colour more or less intense, according to the quantity of the blood.

To recapitulate: 1. If the stains or scales of blood appear recent, the corpuscles may, after the necessary precautions, be examined under the microscope, and their presence, diameter, &c., observed, which will enable one to diagnose the origin of the blood, whether human or animal. 2. If the stains be old and the blood changed, the reaction with the tincture of guaiacum would make the presence of blood probable; but its actual presence cannot be affirmed without spectrum examination, or the production of crystals of hydrochlorate of hæmatin: one of the two is sufficient. It is unnecessary to add that these reactions do not show whether the blood is human or animal.

PROCEEDINGS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

General Monthly Meeting, December 1st, 1873.

GEORGE BUSK, F.R.S., Treasurer and Vice-President, in the Chair.

The following Letter to the Family of the late President was unanimously adopted by the Members present:—

"The Members of the Royal Institution beg to be permitted to express to the family of their late President, Sir Henry Holland, their deepest sympathy in the great loss they have recently sustained. It is a loss in which the Institution largely shares; and it has to deplore a President esteemed by all for his distinguished scientific and literary attainments, for the abilities and varied experience he brought to the performance of his duties; and beloved for the uniform kindness and consideration with which he discharged them. In the published record of his life Sir Henry Holland has acknowledged that his connection with the Royal Institution had been very valuable to him. It is now for the Members of the Institution to testify their profound sense of the exceeding advantages conferred by that association upon the Royal Institution. In it, as he himself has related, he stood by the cradle of some of the most wonderful discoveries of the age, and watched their progress to maturity and fame. He was one of the earliest to witness the production of the alkaline metals by Davy, and among the first to see the small luminous spark elicited from the magnet by Faraday. In later times he was foremost in establishing the Royal Institution Research Fund, and was unceasingly generous in his own large personal contributions to it. As President he was always at his post, ever prompt with assistance and counsel; a sound adviser and a courteous friend. The recollection of his presence in the Institution will not soon be forgotten, and will long remain to be cherished by its Members with affection and regard. The close of such a career must be noted with no ordinary feelings of interest and regret, and the Members of the Royal Institution desire to assure the family of their lamented President how fully they enter into the universal sorrow for his death."

Mrs. Walter Fawcett, and Mr. Charles Craddock Underwood were elected Members of the Royal Institution. The Duke of Northumberland, D.C.L., was unanimously elected President of the Royal Institution, in the room of the late Sir Henry Holland.

The following lecture arrangements for the ensuing season were announced:—

Christmas Lectures (adapted to a Juvenile Auditory).

Professor Tyndall, D.C.L., LL.D., F.R.S. Six lectures on "The Motion and Sensation of Sound," on Dec. 27 (Saturday), Dec. 30, 1873; Jan. 1, 3, 6, 8, 1874. Before Easter, 1874.—Professor Rutherford, M.D., F.R.S.E. Eleven lectures "On the Nervous System," on Tuesdays, Jan. 13 to March 24. Professor P. M. Duncan, F.R.S. Seven lectures "On Paleontology, with reference to Extinct Animals and the Physical Geography of their Time," on Thursdays, Jan. 15 to Feb. 26. Professor W. C. Williamson, F.R.S. Four lectures "On Cryptogamic Vegetation," on Thursdays, March 5 to 26. Professor G. Croom Robertson, University College, London. Four lectures "On Kant," on Saturdays, Jan. 17, 24, 31, and Feb. 7. R. Bosworth Smith, Esq., M.A. Four lectures "On Mohammed and Mohammedism," on Saturdays, Feb. 14, 21, 28, and March 7. Charles Thomas Newton, Esq., M.A., Keeper of Greek and Roman Antiquities, British Museum. Three lectures "On Ephesus," on Saturdays, March 14, 21, and 28.

The Friday Evening Meetings will commence on January 16, at 8 o'clock p.m. The Discourse will begin at 9 o'clock.

Friday Evening Discourses during the Season will probably be given by Professors Tyndall and Sylvester, Sir Julius Benedict, Mr. A. H. Garrod, Dr. Doran, Mr. Vernon Heath, Mr. Francis Galton, Dr. Burdon Sanderson, M. Cornu, Dr. Carpenter, and Professor Ramsay.

Chair of Chemistry Carmichael School of Medicine (Richmond Hospital) Dublin.—C. R. C. Tichborne, Ph.D., F.C.S., M.R.I.A., &c., has been appointed Professor of Chemistry to the above School of Medicine.

NOTICES OF BOOKS.

Les Engrais Perdus dans les Campagnes. (The Manures Wasted in the Country.) PAR M. DELAGARDE. Paris: Librairie Centrale d'Agriculture et de Jardinage.

This work calls attention, perhaps in a rather more rhetorical style than would be admired in England, to the serious waste of manurial matters taking place in France. This waste is estimated, apparently without exaggeration, at 2 milliards of francs yearly. He considers human excrement to have more than one-and-a-half times the value of sheep's dung, twice that of horse-dung, and three times that of cow-dung. The dejections of an adult person he estimates to have an average yearly value of 28 francs. Poudrette, a form in which night-soil is commonly used in France, he considers to have lost five-sixths of its fertilising properties, a view which we see no reason for disputing if the method of its preparation is fairly considered. It must be noted that the author confines his estimates and recommendations to the rural districts. Of the loss in the towns and of the method of preventing it he does not treat.

Now many persons will be inclined to deny that any waste of manurial matter takes place in the country. They will ask, What can become of the excrements of man and beast if not applied to the land? But, before manures reach the spot where their action is wanted, they are often suffered to lie for a long time fermenting, and allowing their most valuable constituent, ammonia, to "waste its sweetness on the desert air." No less are they injured, in a majority of cases, by the loss of their soluble constituents, such as phosphoric acid, potash, magnesia, &c. It is something quite common, in passing a farm-yard, to notice a dribble of deep brown liquid oozing from the manure heap, and finding its way to the nearest ditch. Hence, after nourishing the weeds along the water-course, it ultimately flows into the same brook and aids in the pollution of our rivers. In like manner, the village cesspools too often will be found draining into the ponds and streams. Thus, though the manure is ultimately carted in due form upon the fields, it is, comparatively, a mere inert residue deprived of its most valuable constituents. The author proposes to arrest such escapes by substituting for the cesspool portable chests, in which the excrement is brought into contact with copras, sulphate of lime, &c., to fix the ammonia. The contents of these chests can then be regularly withdrawn and applied to the soil. The drainings of dunghills, and the urine, a very large proportion of which runs to waste, both in town and country, he proposes should be carefully collected in appropriate pits or tanks. A mixture which he suggests for absorbing both the volatile and the liquid constituents of excrements is composed of 18 double decalitres of dry earth, powdered and sifted; 3 double decalitres of ashes; 2 double decalitres of gypsum; and 1 double decalitre each of slaked lime and of charcoal dust. In a following section he refers to the waste of dead animals, which are often buried entire in pits. The water in which sheep or parcels of wool have been washed, and the liquid resulting from the retting of flax and hemp, have also considerable manurial value, and, as the author points out, are only used accidentally. He shows that the non-edible fungi, which in some parts of the Continent are very abundant, contain in their moist state about 1.5 per cent of nitrogen, and are consequently well worth collecting as manure. He protests, also, against the burning of straw, by which its nitrogen is dissipated and its mineral constituents thrown into a less available condition. What would be his opinion of a new agricultural steam-engine specially arranged to burn straw, and recommended as a great improvement.

This work, although it does not profess to contain anything new to the agricultural chemist, is likely to be very useful. It calls attention, in a plain, unpretending manner, to losses which, though individually trifling, amount in

the course of a year, and over the extent of a whole country, to sums of national importance, and it points out simple methods for their prevention. The lesson is worth attention on both sides of the Channel.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopaedic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgement. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, October 27, 1873.

Sixth Note on Guano.—M. Chevreul.—The author has found in guano crystals containing three bases—potash, ammonia, and lime combined with oxalic acid. They are soluble in water, and the concentrated solution is not rendered turbid by oxalate of ammonia, even after the lapse of forty hours. If the solution is much diluted with water, and allowed to stand, it loses its transparency and becomes turbid. The opacity is due to the deposition of oxalate of lime. He has also discovered urate of lime in guano. His researches on guano have revealed facts of crystallisation analogous to this, which he communicated to the Academy regarding the salts of dead bodies.

Purification of Hydrogen Gas.—M. Ch. Violette.—The author finds that if hydrogen is prepared from zinc, and purified according to the method of Dumas, it contains no gaseous compounds of carbon. If instead of zinc, iron (whether wrought or cast) be used gaseous hydrocarbons are produced, and accompanying the hydrogen. Whether carbon exists at all as an impurity in zinc is doubtful, if we consider the mode of its extraction.

Sugar Contained in Vine Leaves.—M. A. Petit.—A kilo. of vine leaves yielded 15.8 grms. of cane-sugar, and 17.49 grms. of glucose. A kilo. of peach leaves yielded 33 grms. of cane sugar, and only 12 of glucose.

Reply to a Note of M. Respighi on the Extent of Variations of the Solar Diameter.—P. Secchi.—In opposition to M. Respighi the author finds no difference in results, with the objective prism and with the interposed prism. The small value he obtains for the solar diameter diminishes by five or six seconds the diameter given in the "Nautical Almanack" ($32' 13'' \pm$). This result agrees with that of Encke, who gives $31' 56''$ and with that of M. Mazzola, lately published in Turin, $31' 57''$; the influence of atmospheric obscuration, irradiation, &c., having been eliminated.

Researches on Crystalline Dissociation; Evaluation and Distribution of Work in Saline Solutions. (Continued.)—MM. Favre and Valson.—When salts of strong acids are dissolved in sufficient water there is established in the liquor, and between the elements of the salts, an equilibrium such that each of the metalloidal radicals may be supposed associated with one of the metallic radicals, and reciprocally. This appears specially from the observation of phenomena of *thermo-neutrality*, which has been deduced from the existence of thermal modules. Having studied the question as regards variations of volume accompanying the phenomena of solution, the authors find that the densities of saline solutions have relations of a similar nature. There are modules of density as there are thermal modules; and there is a

neutrality with reference to density as with reference to heat. The authors, for convenience sake, designate this *densi-neutrality*.

New Process of Condensation of Liquefiable Matters Held in Suspension in Gas. (Reply to M. Colladon.)—MM. Pelouze and Audouin.—The authors state that the novelty in their invention is the reflecting condensation in the dry state, by simple shock of finely-divided liquefiable matters without the intervention of water, or of any liquid solutions, and without cooling surfaces, both of which M. Colladon employs.

Results of Experiments made at Hyères on the Destruction of Phylloxera by Sulphide of Carbon.—M. Bazille.—The entire cost of treating each stock is estimated at not over 50 centimes.

Action of Condenser on Induction Currents.—Lecoq de Boisbaudran.—While physicists generally admit (the author thinks) that the spectral modifications, produced by introduction of a Leyden jar into the induced circuit, are due to variations of the temperature, and not to any particular alteration in the physical nature of the discharge, he yet offers some remarks in support of this view:—1. One may observe the thermal superiority of the condensed spark over the ordinary spark on comparing together the spectra obtained, under different conditions, by means of the same substance. 2. The effects of the condenser being due to increase of temperature, there is gradual passage from the spectra obtained with the arcule of the ordinary spark to those when a powerful Leyden jar is employed. 3. The action of the condenser does not appear the same in different spectra. 4. The different lines of the same spectrum are not always equally affected by the condenser. 5. The lines intensified by the condenser become nebulous and enlarged. 6. The broadening of narrow lines at high temperature is explained by the perturbations undergone by the molecular movements, when the forces applied are considerable. 7. The lines of emission of solid or liquid substances are nebulous. 8. It seems necessary to distinguish two kinds of continuous spectra proceeding from those of the second order, viz., (a) spectra, the lines of which are enlarged by increase of temperature; (b), those, the lines of which owe their enlargement to the little freedom of the molecules. If, as it seems, there is sometimes a gradual transformation of the shaded bands of a spectrum of the first order into the narrow ones of one of the second order, it is in consequence of an increase of temperature. 9. The sparks of different induction coils present spectral differences to the inequality of the temperatures developed.

Liebig's Annalen der Chemie und Pharmacie.
October 4, 1873.

On Bromotoluols and the Behaviour of their Hydrogen Atoms. (Part I.)—H. Hübler and J. Post.—A lengthy treatise, extending to 66 pages. The authors, who have been assisted in their researches by Retschy, Hässelbarth, Weiss, Terry, and Müller, treat firstly of crystalline para-brom-toluol and its derivatives, such as α -para-brom-sulphi-toluol, α -para-brom-sulphinito-toluol, α -para-brom-sulphi-benzoic acid, β -para-brom-sulphi-toluol, β -para-brom-sulphinito-toluol, β -para-brom-sulphi-benzoic acid, ortho-sulphi-toluol, and toluol-sulph-hydrate. Liquid ortho-brom-toluol is next examined, with its derivatives, ortho-brom-sulphi-toluol, ortho-brom-sulphinito-toluol, ortho-brom-sulphi-benzoic acid, and meta-sulphi-toluol. In succeeding chapters, the authors show the place of the sulphi group in the crystalline brom-toluol, the inability of the isomeric derivatives of brom-toluol to pass into each other by the action of heat, on the position of the constituents in the brom-toluols formed from bromine and toluol, on uniformities in the proportion of crystalline water, on molecular combinations, and on quantivalence.

Determination of Nitrogen.—S. W. Johnson.—This proposal to use sulphate of soda to replace hydrate of soda in soda-lime has been already noticed.

On Atacamite.—E. Ludwig.—Theoretical considerations on the constitution and possible formula of atacamite, with remarks on brochantite.

Nitro-Derivatives of Naphthalin.—F. Beilstein and A. Kuhlberg.—The authors enter upon an examination of mono-nitro-naphthalin, α and β -dinitro-naphthalin, α -amido-nitro-naphthalin, its sulphate, and mono-nitro-naphthalin reproduced from it. They did not succeed in obtaining a β -diamido-naphthalin. They produced trinitro-naphthalin in four modifications, α , β , γ , and δ , and lastly α and β -tetra-nitro-naphthalin.

Action of Sulpho-Carbonyl-Chloride upon Amides. B. Rathke and P. Schäfer.—It is well known that sulpho-carbonyl-chloride has the property of converting aniline and the amides of the alcohol-radicals into mustard-oils. The authors attempted to prepare two new classes of these oils by means of amido-benzoic acid and benzamide. From the former they obtained a mustard-oil benzoic acid, $\text{CSN}(\text{C}_6\text{H}_4\text{CO}_2\text{H})$, but with benzamide they were unsuccessful in their attempt to form a benzoic oil of mustard.

On Dibenzamide.—P. Schäfer.—In the experiments referred to in the last-mentioned paper, the author obtained a dibenzamide crystallising with two equivalents of water, $\text{NH}(\text{C}_6\text{H}_5\text{O})_2 + 2\text{H}_2\text{O}$.

On a Polycyanide.—W. Heintz.—The substance in question has the same composition as acetone, but its higher boiling-point proves that its molecule is larger than that of acetone. The author takes it to be the analogue of the duplo-sulph-acetone of Wislicenus.

Preparation of Alanin by Means of Cyanide of Potassium, and on Lactyl Urea obtained as a By-Product.—W. Heintz.—Strecker, to obtain alanin, mixes two parts of aldehyd-ammonia with one of hydrocyanic acid, both in the state of aqueous solution, adds to the mixture hydrochloric acid in excess, and evaporates in the water-bath. Heintz proposes to use cyanide of potassium in place of hydrocyanic acid. He also examines the reactions and combinations of lactyl urea.

Constitution of Natural Silicates.—Dr. K. Haushofer.—A purely hypothetical paper.

On the Polydenes, and on the Transformation of Ethylen into Ethyl-Alcohol.—W. Goriainow and A. Butlerow.—The authors set out with the object of polymerising ethylen. In this they were not successful. Alcohol was obtained in quantity by passing ethylen into concentrated sulphuric acid heated to from 100° to 175° , distilling the acid liquid with a plentiful addition of water, and treating the distillate with potash.

Protein Substances. (Second treatise.)—H. Hlasiwetz and J. Habermann.—The authors saw reason to admit a relation between these bodies and the hydrates of carbon. On treating casein with dilute hydrochloric acid and chloride of tin, the authors obtained glutaminic acid, leucin, and tyrosin, asparaginic acid and ammonia. No hydrates of carbon nor derivatives of such bodies appeared, whence the view stated at the outset of the paper cannot be maintained.

Compounds Belonging to the Camphor Group.—J. Kachler.—The author examines pimelic acid and its ammonium, calcium, barium, magnesium, copper, and silver salts, pimelic ethyl-ether, anhydrous pimelic acid, chloride of pimelic acid, sulpho-camphylic acid, its lead salt, and its behaviour with nitric acid, and concludes with hypothetical speculations on the constitution of certain members of the camphor group.

Isomeric Amylens obtained from the Amylic Alcohol of Fermentation.—F. Flavitzy.—A preliminary notice. The author mentions the following peculiar reaction: if ethylamyl ether is treated with

anhydrous phosphoric acid, and the product condensed in a well cooled receiver, a liquid is obtained, which boils at 35° , and which is probably amylene.

Synthesis of Anthracen and of Dimethyl Anthracen.—W. A. van Dorp.—Benzyl-toluol, prepared according to Zincke's directions, and having a constant boiling-point of from 275° to 277° , was passed through an ignited tube filled with pumice stone, and became converted into anthracen, which when pressed and re-crystallised from glacial acetic acid is pure. It melts at 213° , and contains—

Carbon	94.38
Hydrogen	5.86

100.24

It was capable of conversion into anthrachinon and alizarin by the ordinary methods.

On Cœrulignon and its Derivatives.—C. Liebermann.—This paper is unsuited for abstraction; the author gives for cœrulignon the formula $\text{C}_{16}\text{H}_{10}\text{O}_6$, and shows that it is probably a chinon.

On Penta-brom-resorcin and Penta-brom-ormin.—C. Liebermann and Aug. Dittler.—The authors confirm the formula given by Dr. Stenhouse for the former body, $\text{C}_6\text{HBr}_5\text{O}_2$.

Les Mondes, Revue Hebdomadaire des Sciences, par L'Abbé Moigno, Tome xxxii., No. 11, November 13, 1873.

M. E. J. Maumené states that he has discovered two great laws by means of which it becomes possible to calculate the totality of any chemical action whatsoever. He expounds his views at length in a periodical, entitled *Petites Annales de Chimie*. He pronounces the idea of substitution "one of the most fatal ever introduced into science."

No. 12.

This number contains a highly eulogistic notice of the late Dr. Calvert, who was well known in French scientific circles. There is otherwise nothing calculated to interest the chemical reader.

Reimann's Färber Zeitung, No. 42, 1873.

Vat for Woolen Dyeing with Zinc-Powder.—For a vat of 500 litres, dissolve 30 lbs. of soda crystals in water, add 2 lbs. of ground indigo, and 15 lbs. of powdered zinc. The whole is stirred well together, adding 15 lbs. of ammonia (? the strength), and a solution of 14 lbs. of carbonate of ammonia. The whole is once more well stirred, allowed to settle, and heated to 40° to 50°R . It is immediately ready for dyeing. For every pound of indigo added subsequently there are required $\frac{1}{2}$ lb. of zinc-powder, 2 lbs. of soda, 1 lb. of ammonia, and $\frac{1}{2}$ ozs. of carbonate of ammonia.

The Royal College of Science (Ireland).—We announce with gratification that Professor Galloway has been appointed Dean of the Royal College of Science for the year; and that the Lords of the Committee of Council on Education have decided to amalgamate the Professorships of General and Applied Chemistry in the College. These changes are the result of the retirement of Sir Robert Kane, the promotion of Dr. Sullivan, and the death of Dr. Barker. The reward bestowed upon Mr. Galloway is only a fair, and too long delayed, recognition of his eminence as a philosophical and practical teacher, and of the zeal and energy he has applied to his duties in the College of Science, and the striking success that has attended the performance of them. The arrangement now made will be for the benefit of the institution, in the prosperity of which the Irish people are so much interested. —*Morning Mail.*

THE CHEMICAL NEWS.

VOL. XXVIII. No. 733.

THE ATOMIC THEORY.

By C. R. A. WRIGHT, D.Sc.

A CORRESPONDENT adopting the signature "Atom" distinguishes, in your columns, between the atomic theories of Leucippus and Dalton, stating that "the first is open to discussion, and will long be . . . the second . . . is not. We must learn much concerning matter before we can say with certainty that it consists primarily of indivisible particles or atoms." He also states that, in writing his paper, he seeks "only to make an arrangement in discussing the Daltonian chemistry."

From the tenor of his note, it would seem that "Atom" does not look upon the views propounded by Dalton, and subsequently extended by others in quite the same light as other writers. Dalton himself ("New System of Chemical Philosophy," Manchester, 1808, p. 213) states that "it is one great object of this book to show the importance and advantage of ascertaining the relative weights of the ultimate particles both of simple and compound bodies;" and throughout the work the terms "atom" and "ultimate particle" are used perfectly interchangeably. On page 141 Dalton puts forth his hypothesis thus: "All bodies of sensible magnitude, whether liquid or solid, are constituted of a vast number of extremely small particles, or atoms, of matter."

Later writers have almost uniformly attributed to Dalton the credit of adopting Leucippus's hypothesis, and making it account for the facts (first brought to light by him, i.e., Dalton) of combination in multiple proportion. Gmelin ("Handbook," vol. i., p. 145) states that, "according to the atomic, corpuscular theory, matter is an original essence, and consists of certain very small parts, called atoms, molecules, or particles." . . . In the ancient atomic theory "the atoms are supposed to be actuated, not by any attractive force, but by a motion existing from all eternity (Leucippus, Epicurus, Democritus, Lucretius, Lesage);" according to the modern atomic theory (of Dalton and his disciples), "the atoms are supposed to be impressed with innate forces which give rise to the mutual attraction."

The difference between these theories, *quoad* the final indivisibility of matter, is *nil*. On the other hand, a meaning has been latterly attached to the term atom wholly different from that applied to it by Leucippus, Dalton, and modern physicists, e.g., Clerk-Maxwell, LeDure on Molecules to the British Association, Bradford Meeting (*Nature*, Sept. 25, 1873, p. 437). The transition is thus indicated by Dr. Odling (Watts's "Dictionary," article on "Atomic Weights"): "At the present day, the word 'atom' is most generally employed by chemists [in contradistinction to the term 'proportion' used by Davy]; but, while some use it in its strict Daltonian materialistic sense, others use it in an abstract sense, only to express the smallest indivisible combining proportion of a body, and consider the proportional number of a body as an ultimate or unexplained property pertaining to it." From the general tenor of "Atom's" note, it would seem as though he attributed to Dalton the views really propounded by later chemists, and thus expressly stated to be entirely different from the ideas conceived by Dalton himself as to the meaning and application of the term atom.

A careful comparison of the writings of modern chemists on this subject leads to the conclusion that many of these chemists admit that the question of the actual existence of the Leucippus-Epicurus-Dalton-Clerk-Maxwellian ultimate particle or atom is in no way raised in chemistry; it may, indeed, be assumed, as when Kekulé accounts for

the identity of 1:2 and 2:3 benzin derivatives by assuming a peculiar kind of vibratory motion amongst the hydrogen and carbon atoms constituting the benzin ring, or when the chemist attempts to account for the fact of combination in multiple proportions. But it is not a necessary condition; on the contrary, numerous arguments tend to show (and not the least, Norman Lockyer's most recent researches) that the hypothesis that sixty-five or more essentially different kinds of atoms exist is not in accordance with the whole range of known facts. To bring this forward somewhat pointedly has been the sole object of the writer's papers on this subject heretofore.

The atom now referred to by many chemists is not the same thing as the atom of Leucippus, Dalton, and other physicists; the term connotes wholly different ideas. What is described by these chemists as the "atomic theory" is in fact neither a theory nor is it atomic; i.e., it does not involve the assumption of any proposition incapable of experimental proof (such as the assumption that matter is constituted in a particular way), nor does it refer to the special proposition of the existence of ultimate indivisible particles. It might with more justice be called the *greatest common divisor* system, inasmuch as fundamentally it is a system for co-ordinating chemical facts based upon the ascription to the various elements of numerical values, which are the greatest common divisors of the weights of the various elements obtainable from constant bulks of their gaseous compounds respectively.

The atom of Leucippus and Dalton has no longer a place in this system of chemistry, saving in special cases where it is referred to as a means of explaining the facts collected together in the system. Let the chemists who admit that the question of the actual ultimate indivisibility of matter is not raised in chemistry generally, also agree to use no terms which imply the raising of the question and its mental decision in the affirmative. Let the terms atom, molecule, atomic weight, &c., &c., be replaced by words not involving by implication the assumption, so that these terms may revert to their legitimate use as employed by the physicist; then will the reasoning of such chemists be less unphilosophical and illogical than it often is at present, whilst the student will be spared much mental confusion, and there will be less room for controversy based on misapprehensions as to the meanings attached to the words employed.

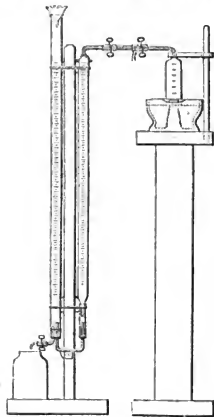
A SIMPLE AND CHEAP APPARATUS FOR THE ANALYSIS OF GASES.

By T. BEESLEY, F.C.S.

For some time past I have used a little apparatus for gas analysis, which is so readily constructed from the ordinary materials of the laboratory, is so easy of manipulation, and so satisfactory in its results, that I am induced to bring it to the notice of other chemists.

The apparatus, like that of Regnault, of which it is a modification, consists of two parts:—A laboratory vessel and its trough, in which to receive the gas and submit it to the action of absorbents; and a graduated tube and its adjuncts, in which it is measured and, if necessary, exploded. The laboratory vessel is a cylinder, about 3½ ins. high, and 2 ins. in diameter, holding about 70 c.c. It is drawn out at the top, and a piece of stout thermometer-tube with a fine cylindrical bore, 3 ins. in length, is fused upon it, and bent at a right angle a little above the junction. The measuring-tube is about 20 ins. long, and ¼ in. in internal diameter, and has another similar piece of thermometer-tube attached in the same way to its upper extremity, and bent in the same way. Its lower end is drawn out, so as to allow of a double caoutchouc connector being firmly tied or wired upon it. To the other end of this connector a glass tube, bent twice at right angles, and with the limbs 14 ins. apart, is fastened in like manner, leaving about ½ in. between the ends of the two glass tubes. The second

limb passes through a cork firmly thrust into a piece of combustion-tube 4 or 5 ins. longer than the measurer, and projects $\frac{1}{4}$ in. above the cork, the aperture being contracted. The cork carries another bit of right-angle tube, which, with a caoutchouc connector and spring-clamp, forms a mercury-tap. Both tubes are fixed by means of wire and a few slices of cork to the opposite sides of a square mahogany rod mortised into a solid foot. The measurer has platinum wires fused into it just below the top, and is carefully graduated into cubic centimetres and tenths, and has a millimetre scale etched upon it, and is then calibrated. In the latter case, a millimetre scale is also scratched upon the filling- or pressure-tube, to assist in the adjustment of the mercury-level. If the tube is graduated for capacity, a similar scale may be laid down upon paper pasted to the front of the support. The capillary-tube of the measurer has another bit of thermometer-tube, 2 ins. long, joined to it by a good caoutchouc connector, leaving the ends of the



tubes $\frac{1}{2}$ in. apart, so that it may be closed by a spring-clamp. This space may with advantage be occupied by a piece of smaller caoutchouc tube fitting tightly into the larger one. The tube of the laboratory vessel is also provided with a similar connector, which, in use, is slipped over the middle tube, and secured by a few turns of twine. A clamp closes this junction also.

In using the apparatus, an ordinary porcelain mercury-trough is so supported that the capillary-tube of the laboratory vessel standing on its shelf is on a level with that of the measurer. The stand which carries the trough is merely a prism of deal, 3 ins. in section, to the top and bottom of which are fastened pieces of board, 7 x 6 ins. On the right-hand side of the board serving for table, a slender rod is fastened, upon which slides stiffly, by means of a perforated cork, an elastic wooden clamp, which, grasping the neck of the laboratory jar, supports it firmly, whilst allowing of the needful motion. The flexibility of the connectors allows of the depression of the jar to the bottom of the trough, when necessary. The laboratory vessel is filled by suction in the usual way, and the clamp then closed, leaving a drop or two of mercury in the free part of the connector. The measuring-tube is filled by

pouring mercury into the pressure-tube through a small glass funnel with a contracted aperture. Care must be taken to remove every bubble of air from the two-limbed tube, which may be easily effected by strongly tapping the stand after some mercury has been poured in. When mercury runs from the capillary tube, the clamp is put on, and the end of the tube is thrust into the connector of the jar, and fastened with twine. The gas for analysis is now introduced into the laboratory vessel, mercury is allowed to flow out of the tubes, the clamps are opened, and the gas passes over into the measurer. When the mercury has reached a mark on the horizontal part of the tube of the jar, the clamps are closed, the flow of mercury stopped, and enough of the latter poured in to equalise the pressure. All is now allowed to acquire the temperature of the air, which, as the apparatus has been but little handled, takes but a few minutes, and the level of the mercury then quickly re-adjusted and read off, noticing the temperature by a thermometer hanging from the tube of the measurer.

The rest of the process differs so little from that of Regnault, to be found in many manuals, that it is unnecessary to further describe it; it must, however, be recollected that the gas must always be measured under the pressure of the atmosphere. In exploding gases in the measurer, the elasticity of caoutchouc so reduces the violence of the shock that there need be no fear of fracture or derangement of the apparatus. When, however, great contraction is likely to occur, which might draw over the whole of the mercury, followed by air, into the measurer, it is desirable to compress the connector at the bottom of the latter with the clamp or the fingers, so as to get time to pour in the mercury. After explosion, half-an-hour at least should be allowed for cooling. At the time of explosion, as well as during the time of cooling, the capillary-tubes should, of course, be full of mercury. Much would be gained in time, as well as in calculation, and something perhaps in correctness, by enclosing the tubes in a cylinder of water, as in Regnault's apparatus, but this would be at a sacrifice of portability, which is one of its chief merits. Having a convenient underground room of pretty constant temperature, I have as yet not been tempted to try this modification. Experiment has shown that, with proper care, there is no appreciable loss by diffusion through the india-rubber. Hydrogen, after standing for one and two hours, gave almost exactly the calculated contraction when exploded with oxygen. Carbonic acid did not alter in volume in three hours, but when both clamps were open, so as to expose a far greater surface of caoutchouc to the jar, it lost 0.2 c.c. in thirty minutes. Such a case would never occur in the course of an analysis.

As a measure of the capabilities of the apparatus, I give the proportions of oxygen obtained in thirty analyses of air collected under different atmospheric conditions, and from different spots in this town and neighbourhood, and previously deprived of CO_2 , made during the last three months. The highest is 21.09; the lowest is 20.82; the mean is 20.95. The higher numbers are mostly after heavy rains, during high winds, or from air collected on heights at some distance from habitations. They agree with those of Angus Smith ("Air and Rain") in showing that the proportion of oxygen in pure air slightly exceeds that commonly given in books. The eudiometer used was somewhat smaller than that previously described, and was not intended for so delicate an investigation; of course, the CO_2 cannot be determined in such an instrument. The following analysis of coal-gas supplied to this town was made in May last:—

CO_2	=	0.70
O	=	0.29
CO	=	6.33
CH_4	=	42.16
C_2H_2	=	6.23
H	=	43.25
N	=	1.64

100.00

Doubtless, improvements may be made upon this eudiometer; hitherto it has answered all my requirements. Perhaps it might be made of larger size, and yet not be liable to leakage or fracture; the present size requires about 20 lbs. of mercury for eudiometer and trough. In the analysis of coal-gas, &c., where much is done by absorption, I use another similar apparatus without platinum wires, of the same height, but of somewhat greater capacity, for the earlier operations, completing the analysis in the exploding one, which is readily substituted for the former. This obviates the possible soiling of the exploding instrument by potash, &c., which is troublesome to remove during an analysis.

ON THE
ANTISEPTIC AND DISINFECTING POWER OF
IODATE OF CALCIUM.

By E. SONSTADT.

In the first of my papers "On the Presence of Iodate of Calcium in Sea-Water,"* I referred to the action of this salt on putrescible matter. Since that paper was published I have continued to make experiments on the properties of iodate of calcium as an antiseptic and disinfecting agent; the experiments have been made with the dry salt, and also with a solution of the salt made by dissolving 1 grm. of the iodate in 1 litre of water. The principal putrescible substances experimented upon have been urine, albumen, fish, meat, and rain-water.

The experiments on urine were begun in the spring of last year. Equal quantities of fresh urine were put into two test-tubes, and to one portion a small pinch of the solid iodate was added: the specimens were placed close together. After a few days the specimen to which nothing had been added became very offensive, and I added to it about a fourth of its volume of the solution containing 1 part of iodate to 1000 parts of water. The next day the offensive odour was gone, but still enough odour remained to make the nature of the fluid recognisable. The specimen to which the solid iodate had been added at no time took any offensive odour, and after several weeks could not even be recognised for what it was by the smell. The minute quantity of solid iodate that had been added to it remained apparently undissolved; up to the present time no sensible odour has been given off by this specimen. I have repeated this experiment several times with like result.

The experiment on albumen was begun on July 30, last year. Two fresh eggs were taken, and the whites put into two similar bottles. A decigram. of iodate of calcium was added to, and shaken up with, the white in one of the bottles, the white in the other bottle being left as it came from the egg, for the sake of comparison. The two bottles were kept side by side, sometimes corked, sometimes uncorked, but were always treated exactly alike. The white of egg to which the iodate had been added remained sweet for about six months, after which it began to get discoloured and to smell disagreeably. It is now of a dirty yellow colour, and has a whitish deposit. The other specimen, containing no iodate, smelt disgustingly after about a fortnight, and is at present of a brown colour with brown deposit. The odour is perhaps now equally strong from both specimens, but there is as great difference between the quality of the odours as in the appearance of the specimens.

The experiments on fish have been chiefly made on herrings. Freshly-caught herrings immersed in iodate water (containing 0.1 per cent of iodate) remain in hot weather perfectly good for about four days, after which they begin to slowly change. If dry iodate is sprinkled over the fish (1 or 2 decigrams. of iodate to a dozen fish) instead of immersing them in the solution, the result is

the same, and in neither case is it possible to detect the slightest foreign flavour in the taste of the fish. It is remarkable that the solid, and very sparingly soluble, iodate of calcium, which, so sparingly sprinkled over the fish, can only be in contact with very small spots here and there, should still exercise its preservative power throughout as completely as when a solution is used; that such is the case has, however, been proved, not by one or two experiments, but by many, since both last season and this, I have very frequently eaten fish kept fresh for a few days after being caught, by the dry or wet method indifferently. Salt herrings, a staple article of food in the Isle of Man in the winter time, have more or less of a disagreeable rancid flavour, whether eaten with or without removal of the salt they have taken up. But if salt herrings are first soaked in water long enough to remove as much of the salt as is considered desirable, and then immersed in iodate water for twenty-four hours, they lose entirely this disagreeable flavour, and are completely restored to the condition as to flavour that they were in when freshly caught.

I have made several experiments on the preservation of meat by the iodate, and have obtained results similar to those described for fish. In the case of meat, the solution of the iodate cannot advantageously be used, since the juices are extracted, and the meat thereby injured. A very minute proportion of the solid iodate, sprinkled over meat, will keep it good for three or four days (in summer time) longer than it will otherwise keep, and, if the meat has acquired a taint before the application, the taint is completely removed; this applies to the cooked, as well as to raw, meat. In one case, I sprinkled over a small joint of beef, which, after cooking, proved to be tainted to the bone and in every part, about a decigram. of the iodate. The iodate was simply dropped from between the finger and thumb over—and, of course, only very partially over—the surface of the meat; yet the next day the meat was as good as it was possible for meat to be, and was eaten with much relish. How the nearly insoluble iodate can have produced such an effect over parts that it could not come near to, I do not understand; I only vouch for the fact.

Putrid rain-water becomes odourless and agreeable to drink twenty-four hours after the addition to it of one-fourth its volume of the 0.1 per cent iodate water. A litre of unfiltered rain-water to which 1 centigram. of the iodate (1-100,000th) was added on the 20th of January, and kept in a bottle, is still, to all the senses, as it was on the day the specimen was taken.

Eggs, immersed in the iodate of calcium solution, were after 2 months not to be distinguished by smell or taste from perfectly fresh eggs; how much longer than a month they may be thus preserved, experience only can determine.

Fresh butter, covered with the iodate solution, loses nothing in quality during three weeks, and would probably have kept good much longer. Butter that has begun to get rancid is greatly improved by soaking for a day or two in the solution, especially if once or twice worked up in it. Salt butter, after the salt has been washed out, and steeped in the solution for a day or two, is, if originally of good quality, made nearly equal to fresh.

Such small quantities of iodate of calcium as may be introduced into food by the treatment described, do not in any way alter the normal taste of the food; the only modification produced is to restore the original flavour when that has been disguised or impaired by commencing decompositions.

In order to ascertain if much larger doses than any that could under any circumstances be introduced into the food eaten at a meal, could produce any injurious effect, I took at various times different doses of the iodate, the largest dose taken being 1 grm. This dose left a slight after-taste in the mouth, but I perceived no inconvenience, except a slight head-ache next day, an increased appetite, and, generally, such effects as might follow taking an ordinary dose of quinine. Some of my friends have tried small doses, such as a decigram. at a time, in some cases with no sensible effect, in others with marked increase of appetite and

increase of vigour. But it is cases of fever and of attack by diseases such as typhus and cholera, propagated by some specific organic poison, that I should expect the exhibition of iodate of calcium to be followed by marked effects. A layman has small opportunity of making experiments in such directions. On one occasion, however, after exposure for some time to foul putrid odours, I found myself attacked by the usual premonitory symptoms of a typhoid fever, and all these symptoms *entirely* disappeared within a few hours after taking about a desigrm. of the iodate: one of my friends can give similar testimony. It appears to me that the iodate acts simply as a tonic on persons in health, but that, when there is an organic virus in the system, it is a potent agent in destroying such virus and in purifying the system. As a minor application, I may mention that the iodate has given speedy relief in cases of tooth-ache arising from caries.

I have made some experiments on the iodates of sodium, potassium, and of magnesium, in reference to any power they might have as antiseptics or disinfectants, but find them, although not quite without effect, very feeble as compared with iodate of calcium.

ON HEAT.*

By FREDERICK GUTHRIE, B.A., F.R.S., &c.

THIS Lecture was mainly devoted to "Temperature and its Measurement."

The lecturer began by showing that ice is lighter than water—an experiment performed by Nature in the floating of ice on water; further, that water as it freezes swells, and in passing from the liquid to the solid state exerts an enormous pressure. Several vessels are perfectly filled with boiled water, so as to deprive them of air, and screwed up. They are surrounded with a freezing mixture, which converts the water into ice, in which condition it occupies a larger volume, is lighter, and exerts an enormous pressure or bursting force.

In the case of gases, it was shown that they do not exhibit the same difference of expansion as liquids and solids, while all expand when heated equally. To prove this, two equal flasks, containing ordinary air and coal-gas respectively, are equally heated by being placed to the same depth in a trough where hot water is poured in, and there is a certain expansion,—bulk for bulk of each being driven out.

Exactly performed, these experiments give these results:—A cubic foot of hydrogen, or any gas, allowed to expand freely under ordinary atmospheric pressure, from the freezing to the boiling-point of water, becomes one cubic foot and three-tenths and six-hundredths (1.36). It is only with gases more easily condensable by cold than pressure that there is a noteworthy variation from this law.

The nearly equal expansion of glass and platinum enables the one to be fused into the other without any risk of fracture by contraction on cooling. Copper and iron might stick together as long as they were hot, but on cooling both would shrink differently, and separate. This equality of expansion of glass and Pt is used by the chemist to enable him to send an electric spark through gas for analysis, while the inequality of expansion is made use of in the construction of pendulums.

Of course the swing of a pendulum is slower the longer it is, and, since every material of which a pendulum can be formed expands by heat, in hot weather it goes slower, because the pendulum is longer. But by means of two metals, and limiting the size of the one, we can regulate and exactly counterbalance the expansion of the greater length of the other, thus keeping the centre of oscillation constant in position.

The mercurial pendulum is another form. There is a glass vessel containing mercury attached to the rod, and

* Abstract of the second of a course of Lectures to Working Men, delivered in the South Kensington Museum on Monday, the 24th ult.

as the rod increases in length the mercury rises and the centre of oscillation is kept at rest, the pendulum having always the same rate of swing. By the superior expansion of alcohol over mercury, atmospheric temperature may be measured. A little diving-bell of platinum, fastened to a platinum wire, and containing alcohol, is plunged into mercury. When the temperature increases the mercury gets lighter and expands, but so does the alcohol,—the alcohol faster, however, and consequently some of the mercury will be driven out of the diving-bell, and there will be an upward pressure. By making the wire very thin an instrument of extreme delicacy can be made; besides, unlike liquid thermometers, it has the index free, and can register freely in the air.

Next, with regard to the force of expansion, and first of all with a solid. An iron pin is snapped by the contraction or cooling of an iron rod fastened to its centre. We may call this force infinite, considering through what a little degree it moves, and remembering the law of Mechanics—that the less the distance of any motion the greater the force. We are not dealing with a mechanical force, but with a physical force, and the same law holds true, for it exerts that enormous pressure in that expansion and in assuming its original molecular state.

An iron bottle is burst when water freezes in it, because, on freezing, the water swells. Most liquids, however, do not swell, but shrink on freezing, as is shown by the cavity formed in them when they solidify. Numerous and exceedingly curious examples of this molecular strain present themselves, and we may have this force locked up in the molecules for an indefinite length of time. Hot molten glass dropped into water solidifies; the outer crust is cold at first; then the inner molecules get cool, and endeavour to contract, either by leaving a vacuum between themselves and the already congealed solid glass, or by establishing a constant internal strain. There is really no more reason why such a vacuum should be formed in one place rather than the other, and the result is, though difficult to prove, that there is this internal strain, which can be distinguished by disturbing any one part where there is unstable equilibrium. Break off a point, and the whole is converted into powder, showing that the strain has been minutely distributed through the whole mass. Annealing glass is the regulation of the cooling of a semi-solid mass, so that the parts may shrink uniformly.

Liquids, when they expand, also exert an enormous pressure, but not so great as solids, as seen in the bursting of a flask full of water when the water is heated. Take a vessel of water mixed with ice, and heat it, and there will be no such reversal as the glass expanding and the water sinking, as is the case with simple water on heating at first, but the effect of the glass will be in the same direction as the effect of the melting of the ice. When the ice melts it gets denser, the water being more dense than the ice from which it is formed, and this continuous shrinking of the mass while heating proves clearly that, bulk for bulk, ice is lighter than water. Now, amongst all bodies in the liquid and solid form, water stands not exactly alone, but among a select number.

Let us now turn to the means which have been employed for the measurement of temperature, briefly describing the construction of thermometers. A good flask, with a well-fitting cork and a narrow tube, are the elements of a thermometer. But we wish to prevent the evaporation of the liquid, and to get rid of the pressure of the air, and to make the liquid adhere to the sides of the tube. It will be advantageous to take a liquid free from air, and shut the vessel off from the influence of the atmosphere in every way; then it is clear that if we are dealing with a ratio or fraction, and we want to measure the amount water or mercury increased when heated through a certain range of temperature, it is advantageous to take a great discrepancy between the capacity of the bulb and the tube or stem. Practically, it is found best to use a bore tube almost infinitesimally small, for the

smaller the amount of liquid the more readily it assumes the temperature to which it is exposed. One takes a tube far narrower than a hair, and the bulb may be filled with either alcohol or mercury; alcohol, if we are dealing with low temperatures, because alcohol has never been frozen; mercury, if we are dealing with high temperatures, because it requires a high temperature to boil mercury, although it can be frozen.

An ounce of mercury immersed in freezing water always has a certain size, and in boiling water it always has another and greater size, while at any intermediate temperature, got by mixing together freezing and boiling water in different proportions, it has an intermediate size. Accordingly, by measuring the size of any constant weight of mercury, we can tell what its temperature is. Plunge the bulb containing the mercury into freezing water, and the mercury shrinks in the stem to a certain point; plunge it again into boiling water, and it rises to a higher mark. The lower mark is sometimes called 0, and the other 100° (Centigrade) or 80° (Réaumur), or the lower is called 32° and the higher 212° (Fahrenheit).

Let us, in conclusion, notice the important fact that water is at its greatest density at 4° C.; at 3° it stands as high as it did at 5°; and at 2° it stands as high as it did at 6°. A frozen pond bears witness to the fact, for the water at the surface is at zero, while the water at the bottom is at 4° C., i.e., the coldest water rises to the surface, and gravity induces the water at its maximum density (4° C.) to go to the bottom.

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, December 4, 1873.

Dr. FRANKLAND, F.R.S., Vice-President, in the Chair.

THE minutes of the previous meeting were read and confirmed, and Mr. F. Brown was formally admitted a Fellow of the Society, after which the Secretary announced the donations which had been made to the library. The names read for the first time were those of Messrs. Frederick E. Harman, William Herbert Pike, Robert Francis Smith, Henry Bowman, Joseph Reddross, R. L. Taylor, William Joseph Spratling, J. Lawrence Smith, and Owen Davies Owen. For the third time—Dr. B. W. Richardson, F.R.S., Dr. Donato Tommasi, Messrs. Charles L. Field, Walter T. Goolden, B.A., Edgar Beckett Truman, Thomas H. Davies, William Masters, Alexander Campbell Dixon, James Baynes, Thomas Janieson, Robert Williamson, Charles James Hislop Warden, Francis Jones, Sidney Knowles Muspratt, Felix M. Rimmingtons, Edward Clemishaw, Samuel Herbert Cox, and Arthur B. Kitchener, who were then balloted for and duly elected.

The first paper, entitled "*Mineralogical Notices*," by Professor STORY-MASKELYNE and Dr. FLIGHT, was read by the former. A specimen which had been sold to the British Museum as aurichalcite, from the Lead Hills, was found, on microscopical examination, to belong to an ortho-symmetrical system, and to possess the same crystallographic form as caledonite. The analyses of the mineral and of an undoubted specimen of caledonite were made, and the results in both cases corresponded to the composition represented by—



indicating a composition corresponding with 3 equivalents of linarite, 2 of lanarkite, and 2 of water. As Brooke states that the mineral contains 9.5 per cent of carbonic anhydride, a determination of the amount present in this specimen was made, and found to be only about 1.4 per cent. The authors think that, as the mineral occurs associated with cerussite, the carbonic anhydride was probably accidentally present in the form of lead carbonate.

An analysis of a very pure specimen of lanarkite showed that it contains neither water nor carbonic acid, but consists of lead sulphate and lead oxide.

The CHAIRMAN, in thanking Professor Maskelyne and Dr. Flight for their interesting communication on this mineral, said he could not help noticing the remarkable coincidence between the number of molecules of metallic sulphate and those of metallic hydrate, there being five of each.

Professor LAWRENCE SMITH, of the United States, said he had analysed many of the minerals from the mines of Pennsylvania, and he might here mention the ease with which citrate of ammonia dissolved lead sulphate. Anglesite, for instance, dissolved readily in a solution of ammonium citrate, and the lead could then be precipitated as carbonate, and the sulphuric acid subsequently determined.

Mr. FIELD remarked that a solution of hyposulphite of soda answered equally well for dissolving lead sulphate; lead carbonate, on the contrary, was very insoluble.

In reply to an observation of Mr. SPILLER, that he had pointed out in 1857 that lead sulphate was particularly soluble in solutions of the citrates, Dr. SMITH said that he had made assays of lead ores by that method as early as 1852.

Mr. JOHN WILLIAMS then exhibited some fine specimens of phosphates, including the crystallised acid; the latter was prepared by the action of water on pure phosphorus trichloride, the solution being concentrated by evaporation in a platinum basin. On allowing it to stand for twelve or fourteen hours, it solidifies to a crystalline mass; the sodium salt was the only one exhibited which crystallises well. On adding the sodium salt to a solution of platinum, the platinum phosphite is precipitated; this dissolves in the liquid when it is heated, and separates in the crystalline state on cooling. The acid precipitates silver and gold in the metallic state, the latter being coherent and presenting the usual metallic appearance; with sodium phosphate, on the contrary, it is precipitated in a very finely-divided state, and has a purple colour. With silver nitrate, the sodium salt gives the bright yellow silver phosphite, which becomes brown when heated. The crystallised acid itself, when strongly heated in a test-tube, gives off spontaneously-inflammable phosphoretted hydrogen.

Dr. FRANKLAND said the members were much indebted to Mr. Williams for showing them the specimens of the phosphites, which had not received that attention from chemists one might expect. It was a new fact that the acid yielded a spontaneously-inflammable phosphoretted hydrogen, it being generally stated that the gas given off under those circumstances was not spontaneously inflammable.

Professor CHURCH then made a communication "*On Autunite*." The published analyses of this mineral usually assigned to it the formula—



Pisani, however, gives it $10\text{H}_2\text{O}$, which is probably correct. The theoretical composition is— U_2O_3 , 60.18 per cent; CaO , 5.91; P_2O_5 , 14.96; $10\text{H}_2\text{O}$, 18.98; whilst $8\text{H}_2\text{O}$ requires only 15.7 per cent. On making an analysis of a specimen of Cornish autunite in beautiful lemon-yellow needles, the speaker found— U_2O_3 , 60.00 per cent; P_2O_5 , 13.84; and H_2O , 18.65; which corresponds to the formula with $10\text{H}_2\text{O}$. In order to obtain additional evidence on this point, crystals of French autunite were carefully selected under the microscope, powdered and dried; over sulphuric acid they lost 8.24 per cent of their weight, and at 100° 6.94 more, in all 15.14. A loss of $8\text{H}_2\text{O}$ would require 15.18. At 180° they lost 3.09, and at low redness 1.03, making 4.12; a loss of $2\text{H}_2\text{O}$ would require 3.79. The speaker said he hoped shortly to be able to complete his results and lay them before the Society in detail.

Professor MASKELYNE observed that there was great difficulty in determining in what state the water existed in a mineral, and when Professor Church gave his complete description of the mineral, he hoped he would state whether

the loss of water over sulphuric acid was accompanied by a breaking up of the crystal. In a very fine specimen of the mineral, which had been about forty years in the British Museum, he had noticed a peculiar abraded or worn appearance of the crystals near the summits, for which he had been quite unable to account.

Professor CHURCH replied that he had observed that the Cornish mineral became somewhat greenish when dried *in vacuo*, but the French, whilst it retained its colour, became opaque. In an account of the corresponding phosphate of uranium and copper, published some years ago, he had noticed that its green colour became changed to yellow on drying.

Professor LAWRENCE SMITH, whilst describing a burner employed by him for heating crucibles, alluded to his process, published some time ago, for separating the alkalies in siliceous minerals, depending on the manner in which lime decomposes the silicates. One part of the pulverised mineral is mixed with 1 part of ammonium chloride, and then 8 parts of calcium carbonate, precipitated by ammonium carbonate from a hot solution of calcium chloride, are added. The mixture is introduced into an elongated platinum crucible, and heated to redness by means of a modification of Bunsen's burner having a sort of mouth-piece adapted to the top of the tube, so as to cause the flame to spread out somewhat like that of a "fish-tail" burner. The fritted mass, after removal from the crucible, is treated with water and ammonium carbonate to precipitate the lime, and the alkalies determined in the usual way; the whole operation on a felspar occupying about two hours and a half.

During the course of the evening a gas-burner, by Mr. F. FLETCHER, of Warrington, was exhibited.

The CHAIRMAN finally adjourned the meeting until Thursday, December 18th, when the following papers will be read:—"Researches on the Action of the Copper-Zinc Couple on Organic Bodies" (No. IV., "On Allyl Iodide"), by Dr. J. H. Gladstone, F.R.S., and Mr. Alfred Tribe; "On a New Compound of Nickel and Phosphorus," by Dr. R. Schenck; "On the Preparation of Standard Trial Plates to be used in Verifying the Composition of the Coinage," by Mr. W. Chandler Roberts.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, November 4th, 1873.

R. ANGUS SMITH, Ph.D., F.R.S., &c., Vice-President, in the Chair.

Mr. Joseph R. Bridson, Mr. James Watkins, and the Rev. William Marshall, B.A., were elected Ordinary Members of the Society.

The CHAIRMAN said that the death of Dr. Calvert, one of the most distinguished members of the Society, called for more attention than he was able to give it, but this meeting of the Society could not be allowed to pass over without a few words regarding the loss which all chemists must feel. It will no doubt be the pleasant duty of some of his friends to prepare a more detailed account of his labours. Meantime he (the Chairman) would express the opinion of all who knew Dr. Calvert by saying that a more diligent student of chemistry has rarely, if ever, been found in any country. It has been remarked that Dr. Calvert's knowledge of the literature of science was something marvellous; this was doubtless owing to his devotion to the subject and his untiring activity and strength. The memoirs which he has written are too numerous to be characterised at present, and already several journals have given the heads of the most important. As a medium of communication between scientific men, manufacturing and professional, in France and England, he was no doubt the means of doing much good in both countries. In the former country he felt almost as much at home as in the latter, having lived there from the time he was fourteen

years of age until he was twenty-eight, and having married a French lady. It was this intimate connexion with France which gave him his French accent, which he could never entirely get rid of. He was, however, entirely English by birth. His habits contradicted there may have been also to that excessive activity which seems to have told at last in a very unexpected manner upon his health, as he seemed powerful and of sound constitution. The fatigues he underwent during a visit to the Vienna Exhibition, and the climate there, must, however, be blamed, so far as we can hear, for the evils both direct and indirect which produced a fatal result. Dr. Calvert had, shortly before his death, completed a revised edition of his lectures on some departments of manufacturing chemistry. His practical experience, combined with his profound knowledge of the theory of the subject, must render such a work of great value, and keep his name for a long time fresh among chemists. His later investigations, especially those connected with germs or the beginnings of life, were of a purely scientific character. He may be said in every sense to have been a successful man until that illness which destroyed a life which promised to be very long. He had many friends, and amidst an excessive amount of work he was able to be obliging and kind to a large number. He was a Fellow of the Royal and Chemical Societies and of several foreign Academies, and in the scientific circles of London and Paris he was as well known as in his adopted city, Manchester, where many lament him as a man who knew little of him as a chemist.

"On the Bursting of Trees and Objects Struck by Lightning," by Professor OSBORNE REYNOLDS, M.A. The results of the experiments referred to in this paper were exhibited to the meeting. The suggestion thrown out by Mr. Basendell at our last meeting—that the explosive effect of lightning is due to the conversion of moisture into steam—seemed to me to be so very probable that I was induced to try if I could not produce a similar effect experimentally.

(1.) I first of all tried to burst a thin slip of wood by discharging a jar through it, taking care so to arrange the wood that the discharge should be of the nature of a spark, and not a continuous discharge. This was done by making the wood to form part of a discharging rod, with balls on the ends.

This experiment was successful in the first attempt, although the results were on a small scale. It should be mentioned that the wood had been damped with water. This experiment was repeated with larger pieces of wood with various results.

(2.) It then occurred to me to try with a glass tube. This I did at first with a very small tube, passing wires from the ends of the tube until they were within $\frac{1}{4}$ inch of each other.

The small tubes burst both with and without water. (3.) I then used a larger tube (about $\frac{1}{2}$ inch bore), using it in a similar manner. The discharge without water produced no effect on this, even when repeated several times, but when the tube is full of water (with the ends open) the first discharge shattered that part of the tube opposite the gap in the wire. This tube was bent in the form of a syphon, and the water stood about 1 inch beyond the gap in the wire on each side of it.

(4.) I then tried a stronger tube which I had been using for insulation. It had a bore of $\frac{1}{2}$ inch, and was $\frac{1}{2}$ inch in external diameter. It was capable of sustaining a pressure of probably 10,000, and certainly 5,000 lbs. on the square inch; that is to say, a pressure of from 2 to 5 tons per square inch. It was about 14 inches long, and bent in the form of a square-ended syphon. The gap in the wire was about $\frac{1}{4}$ inch, and the water extended about 14 inches on each side of the gap. The ends of the pipe were open, and the jar charged in the same manner as before with about 100 turns of a 12-inch plate machine. The surface of the jar is about half a square foot, and the discharge, when effected with the common rod, took place through about 2 inches of air.

This tube was shivered at the first discharge. That part opposite the gap and for some way beyond is completely broken up into fragments which present more the appearance of having been crushed by a hammer than of being the fragments of a pipe burst under pressure. Some of the fragments show that the interior of the pipe has been reduced to powder.

These fragments were scattered to some feet on all sides, but there was nothing like an explosion. I held the pipe in my hand at the time of the discharges, and the sensation was that of a dead blow. There was no noise beyond the ordinary crack of the discharge.

The manner in which this pipe was destroyed clearly showed that a larger one might have been broken. But as it was two o'clock and my fire was out, I did not continue the experiments.

It is not easy to conceive the precise way in which a pressure of probably more than 1000 atmospheres could be produced and transmitted in a pipe of water the ends of which were open. It might have been caused by the sudden formation of a very minute quantity of steam, or by the expansion of the water; but whichever way it was, its effect was due to its instantaneous character, otherwise there would have been an explosion.

When we consider the great strength of this pipe (which might have been used for a gun without bursting), and when we see that it was not only burst, but that the interior of the glass was actually crushed by the pressure, and all this by the discharge of one small jar, we must cease to wonder at the bursting power of a discharge from the clouds.

NOTICES OF BOOKS.

The City Record. Vol. I., No. 51. (Official Journal). New York.

THIS journal is an American "institution" which might with great advantage be imitated in England. It is a Quarterly Report of the "Health Department" of New York. The reader finds in it a list of the various sanitary officials; a record of their proceedings; notices of changes in laws relating to public health; remarks on inhabited cellars, on street cleaning, streets pavements, street garbage, sewerage and drainage, wharves and piers, public markets, slaughtering, fat-melting, stable manure, and night scavenging; removal of night-soil from the city; removal of dead animals, offal, &c.; manufacture of gas; permits; disinfection and disinfectants; impending pestilence, with special notes on the prevention of cholera; city mortality; bureau of vital statistics; sanitary bureau; expenditure of the Health Department; and an official directory. This paper is commonly sold in New York, and any person who wishes to satisfy himself as to the doings and the efficiency of the Health Department can purchase a copy. The nearest representative of this Record in London is the Report of the City Commissioners of Sewers. But this "Report," unlike its American contemporary, is not printed for general circulation; a few copies only are struck off for distribution to official personages. Editors of influential journals may succeed in procuring copies, but to the public they are practically inaccessible. Believing that, as far as sanitary matters are concerned, the Metropolitan Board of Works has not quite reached perfection, we should very much like to see a similar "Record" issued here. Perhaps, as a necessary preliminary, a new sanitary authority would be needed, consisting of men of a somewhat higher intellectual type than the nominees of the vestries.

Under the head "Disinfectants," we learn that the substances most in favour in New York are—Chlorides of zinc, iron, and of manganese; sulphate of zinc; carbolic and creosylic acids. The latter fluids are particularly recommended for the disinfection of drains, cesspools, privies, &c., on the approach of cholera.

CORRESPONDENCE.

INCOMPETENCE OR WORSE.

To the Editor of the Chemical News.

SIR,—In the interest of those of your readers who have a good deal of money staked on the honesty and accuracy of assays of raw material, I send you the following little statement of fact.

A firm of commercial analysts, acting for an importing house who recently delivered me a large consignment of phosphate, return as their assay of it "phosphoric acid 37.27 per cent, equal to tribasic phosphate of lime 82 per cent."

My chemist, finding their result a good deal higher than his own, was led to examine their certificate, and, immediately perceiving its inaccuracy, wrote to them asking for an explanation of their calculation. He received no reply to his letter, and the sellers coolly maintained that their chemist's result was correct, being calculated according to the universal usage of the trade!

In the face of my firm protest, they were instructed to assay a subsequent consignment, and their return of that was "phosphoric acid 38.11 per cent, equal to tribasic phosphate of lime 84 per cent." The sellers have since shown me a letter from them, in which they say that they "take 28 as the equivalent of lime, 70 as that of phosphoric acid, and 154 as that of the tribasic phosphate of lime" (!).

As, however, these "equivalents" only apply to their first assay, and their atomic weights for the second have not been communicated to me, perhaps some of your readers can help me out of my dilemma. Seriously, I am asked upon the first cargo to accept an assay return based on "equivalents" which make an amount in money over that of the real equivalents by some £13 to £14. For the second lot, a return is handed me which gives £14 to £15 over the true value, £11 to £12 of this being doubtless explained by the "equivalents," and £2 to £3 by a slovenly error in the calculation which would discredit any boy in our elementary schools.

I need not comment further on this *chef d'œuvre* of commercial assaying, when I say that the sellers have since withdrawn their invoice based on the "equivalents," and substituted another calculated properly from the phosphoric acid. I have, however, of course refused to recognise or respect the assays in any shape. To say nothing of the probability of the phosphoric acid itself having been calculated with home-made "equivalents," the way in which the decimals are burked is enough to take away one's breath. Even the first decimal is wrong; and every tyro amongst your readers will know that in the case of a cargo of phosphate at present prices the third decimal represents a considerable money value: what is said of the tricalcic phosphate applies, of course, with still more force to the more valuable phosphoric acid. I dwell on this because I have of late observed a tendency in other quarters to neglect that scrupulous care and exactitude which should characterise the work of every chemist. Certainly "work" such as I have here instanced cannot be too strongly reprehended. Manufacturers and consumers have surely sufficient cause of annoyance in the great discrepancies between honest analyses without the deliberate introduction of false equivalents. All, therefore, who are interested in the integrity and accuracy of assays and analyses, and in the maintenance of our English commercial morality and honour, should unite to put down this kind of thing with a firm hand.

I confess that, on public grounds, I have been very strongly tempted to publish the names of the offending parties. If, however, a milder course than an *exposé*, which would simply finish their reputation, will suffice to stimulate and maintain that strong public opinion which must alone make such practices impossible, I shall only be too glad, as I have no personal animus in the matter.

With regard to the other parties to the transaction—the commercial house (and one, too, whose name is very widely known)—I should have been disposed to attribute their action in the matter to sheer ignorance. That, however, cannot be fairly said of them. They would, at all events, very strongly resent the imputation. They are known as men who pride themselves very much upon their trade knowledge and experience, and are, in fact, continually laying down the commercial law upon any matter. I think, Sir, I must leave them to assess their own motives in this discreditable transaction.—I enclose my card, and am, &c.,

VERITAS.

LEWIS THOMPSON, M.R.C.S., &c.

HYDROGEN AND SOLUTION OF NITRATE OF SILVER.

To the Editor of the Chemical News.

SIR,—It would appear from a note by Mr. Wanklyn in the last number of your journal, that some remarks which I made at a recent meeting of the Chemical Society, *apropos* of Dr. Russell's paper "On the Action of Hydrogen on Silver Nitrate," have been erroneously reported. It is implied by Mr. Wanklyn's note that I asserted that the solubility of hydrogen in water diminishes with rise of temperature. What I did say was, although it is well known that hydrogen is equally soluble in warm and in cold water, it would be interesting to ascertain whether or not such uniformity prevails in its solubility in saline solutions, such as the silver nitrate.—I am, &c.,

A. W. WILLIAMSON.

University College, London, W.C.,
Dec. 8, 1873.

IRON FILINGS IN TEA.

To the Editor of the Chemical News.

SIR,—Permit me to add a few words to the observations of Mr. W. M. Williams, contained in your last number, upon the above subject. It is now more than two months since I discovered that the so-called iron filings tea contained no iron filings whatever, and from that time I have been attempting to inform the public of the fact. On October 22, I wrote a letter upon the subject to the *Morning Post*, but the editor of that paper did not think proper to publish my letter. Up to this time I had examined seven samples of the said tea, but all had been supplied by persons interested in the trade. It seemed to me then necessary, before making further efforts to publish my results, that I should examine an incontestably genuine sample of the tea, said to contain the filings. To procure this tea, I applied on November 1 to a gentleman who holds a high official position in the Corporation, but whose name I decline to publish. This gentleman most willingly undertook to serve me, though his efforts were unsuccessful until Nov. 17, when he forwarded me a genuine sample, duly marked "Tea adulterated with a large quantity of iron filings and sand." This tea, like all the other samples which I had examined, contained neither iron filings, iron turnings, nor metallic iron in any shape or form whatever. Like the rest, it contained magnetic iron ore and granitic quartz. On Nov. 19, I sent a letter stating this fact, and giving the exact composition of the tea, to the *Daily News*, but my letter was not published. On the 22nd, I sent a similar letter to the *Grocer*, with the same result. On the 24th, I sent a letter to the enterprising proprietor of the *Daily Chronicle*, and he published my account of the tea on Wednesday, Nov. 26.

With regard to the iron ore, there is a curious circumstance worthy of notice at present in it. The ore is not hematite, as Mr. Williams supposes, for it is attracted by the magnet. It is magnetic iron ore, and contains a large portion of phosphate of iron, so that it never could be converted into malleable iron, and consequently never has

been, nor ever can be, in the state of iron filings. The granitic quartz is mixed with particles of felspar, mica, and a few fragments of hornblende; it no doubt constitutes the matrix of the iron ore, and thus comes to be associated with it on the tea, where, however, it is a manifest adulteration to the extent, I believe, of 25 per cent. And here let me offer a remark upon tea adulteration; I have found 61 per cent, 121 per cent, and 25 per cent, in different samples of black and green tea, as if the Chinese adulterative mind worked by doubles, and not by decimals; thus, the above amounts of adulteration are 1, 1, and 1-16.—I am, &c.,

IRON FILINGS IN TEA.

To the Editor of the Chemical News.

SIR,—In answer to Mr. W. M. Williams, I may remind him that I concluded that the magnetic particles were genuine iron filings from their solubility "in nitric acid with effervescence" (magnetic oxide being scarcely soluble in nitric acid). Certainly the reduction of copper is a more reliable test, but it did not occur to me to use it. By using the term "real lumps of metal," I did not intend to give the idea of great size, but merely to convey the impression that the particles were greatly larger than filings—probably as large as any of the type used for the title of Mr. Williams's letter.

As to your correspondent's question, "Were these found in the ash or in the unburnt tea?" I may express my astonishment that the published reports show that the chemists examined at the recent Birmingham trials looked for the iron filings in the ash of the tea. The method I have employed has been to powder the tea, and spread it out in a thin layer on a plate. A small electro-magnet has then been passed through it, and the attracted particles treated with hot water, which disintegrates the lumps, and allows the ferruginous matter to subside. The liquid being decanted, the deposit has been weighed, and further examined by the microscope, nitric acid, &c.

The tea in which I found the "lumps" of iron was examined some six months ago from curiosity. On my friend asking for some of the "rough flavoured, thick, sappy, Monong congou" described in the window-bill, the shopman added a portion of tea from a separate canister, and, on reaching home, this was readily picked out from the rest by its different appearance. It weighed about 5 per cent of the total quantity, and, besides the lumps of iron, contained sand, starch, magnesia, and plumbago. The percentage of tannin in it was 20 per cent, while even genuine black tea does not contain more than 14 or 15 per cent at the outside, a fact which I considered conclusive of the presence or catechu or other extraneous tannin matter. It will be evident, therefore, that the weight of metallic iron was not very large—probably a per cent of the whole tea; it was not actually estimated. The main bulk of the sample contained leaves other than tea, a considerable quantity of ferrous sulphate, and only about 5 per cent of tannin. I think these facts will be sufficient to convince Mr. Williams of the desirability of looking after the tea sold. As a matter of fact, the grocers are perfectly aware of the kinds of tea most frequently adulterated, and understand the use of a magnet and hot water as well as we do.

In his postscript, Mr. Williams calls attention to the summary of the magistrates on the Birmingham tea cases, and considers that the evidence is a strong confirmation of his theory of the origin of the iron detected in tea. At any rate, the magistrate thought differently, and, in the face of the fact that genuine teas contain neither magnetic matter nor insoluble silica, could not do otherwise than conclude that these substances had been purposely added to the teas found to contain them.

If Mr. Williams will look again at my letter, he will see that I suspected the English tea-dealers of the addition of

sulphate of iron, not metallic iron, though I remain unconvinced of the difficulty of obtaining the finely divided metal when wanted. At the same time, I fully admit that in the majority of cases the ferruginous matter consists of oxide or titanate of iron, and no doubt was added by the Chinese, probably in accordance with the instructions of the agents of the English merchants.—I am, &c.,

ALFRED H. ALLEN.

PS.—In my last letter, for the words "cayenne to give a sulphuric acid to vinegar," please read "cayenne to gin or sulphuric acid to vinegar."—A. H. A.

Sheffield, Dec. 6, 1873.

IRON FILINGS IN TEA.

To the Editor of the Chemical News.

Sir,—I thought that the "figment" of iron filings being in "tea" was finally set at rest by the decision of the "Stipendiary" in the late tea prosecutions at the Birmingham police-court, but, from what I see in your last two numbers, it is again beginning to be debated.

Having had the management of the chemical defence, it has occurred to me that it would be useful briefly to state the "reasoning," founded on experiment, why I came to the conclusion that not only were there no iron filings in the suspected tea, but that tea is never adulterated with iron filings,—that it is a libel on the Chinese to say that they ever put any in, and I am certain that none would be more astonished at the "charge" than the Chinese themselves.

The certificate given by the analyst of this borough stated that the tea was adulterated with "iron filings, sand, and earthy matter." As to the two last, the analyses of the tea, made by myself and colleagues (Dr. Wrightson, Prof. Murphy, Mr. Horner, and Mr. Scott), showed that this was so, and, finding that the tea stuck to the magnet, I thought, with the "analyst," that there were iron filings in it. But, considering that the Chinese have no vast fitting shops, as we have here, I wondered where they could get the iron filings from; I therefore thought it of great importance to get the iron filings out as iron filings, to do which I reduced the tea to powder, and then made it into a paste with strong alcohol; when this had been dried out, I searched the powder with a magnet, and attracted out some dark brown particles, which formed a "brush," just like iron filings would at the poles of the magnet. On examination, the particles turned out to be magnetic oxide of iron, but there where here and there little brilliant facets of something having a metallic look, which stuck to the magnet with the magnetic oxide, which seemed to me to indicate that the Chinese made a mixture of iron filings and magnetic oxide of iron to dose their tea with.

Up to this moment, therefore, I thought the borough analyst's certificate was correct; but, pondering on the matter, I put the brown magnetic oxides and sparkling particles on a sheet of paper, and, on viewing them with a "magnifier" in a good light, I thought I observed one shining particle which looked somewhat transparent. I then carefully separated it from the magnetic oxide, and, having detached every trace of the magnetic oxide from it, I found that the shining particle did not bounce to the magnet; it was, in fact, a small fragment of quartz, and some of the particles turned out to be mica.

In order to determine if there was any metallic iron at all, I treated the magnetic oxide with dilute hydrochloric acid, in which acid it dissolved without the least effervescence of hydrogen gas, which would have been the case if there had been a trace of metallic iron present, either rusted or bright. I also kept some of the magnetic oxide of iron in a solution of sulphate of copper for five days, without there being a trace of metallic copper precipitated.

Having thus clearly demonstrated that the magnetic oxide of iron is a natural mineral product, the idea occurred

"If the Chinese put it into their tea, what do they put it in for?" for it is as much in green tea as it is in black tea. To answer this, I got out every trace of magnetic oxide from 100 grs. of the tea, and found that it only weighed 0.03 gr., a quantity so small as to be almost invisible, and yet so strongly magnetic was it that the most minute particle adhering to a large leaf (when curled) made it stick to the magnet. It was therefore absurd to suppose that so minute a quantity could be put in for any purpose whatever.

I now proceeded to examine a great number of "magnetic teas," and had London searched for the worst specimens which could be found, one of which was the tea "*ex Sarpedon*," which Dr. Letheby alluded to in his "Memorial to the Commissioners of Sewers" last April. Dr. Letheby will perhaps be surprised to hear that there is not a trace of iron filings in the "*Sarpedon*" tea: neither is there any in any of the magnetic teas which I have examined; but they one and all contain magnetic oxide of iron, and some of them contain oxide of manganese, doubtless derived from the soil of China. Unfortunately, we cannot examine the soil of China; I therefore examined the soil of many gardens in this neighbourhood, and found that, wherever there is black mould, magnetic oxide of iron is in it. If, therefore, leaves come in contact in any way with the soil, such leaves, when dried, will be attracted by the magnet. I recommend those interested in this matter to dry a few ounces of black mould in an oven, and then search it with the magnet, when the magnetic oxide will be readily attracted.

I have examined the dust of African ginger, Cochinchina ginger, East India senna, American hops, chillies from Cayenne, and other vegetable substances from all parts of the world, and they all contain magnetic oxide of iron, but no iron filings.

I just add that the grocers are very sore at the charge about iron filings. They say, "Iron filings neither grow in the ground, nor are they in the juices of plants; if, therefore, iron filings are in tea, in however small a quantity, it must be a fraud, and ought to be punished." My advice, therefore, to the public analysts is to "change front" about iron filings, or they may "catch a Tartar," as was the case in the Birmingham police-court.—I am, &c.,

ALFRED BIRD, F.C.S.

Birmingham Dec. 20, 1873.

ALUM IN BREAD.

To the Editor of the Chemical News.

Sir,—In your last number, Professor Gardner, F.A.S., M.S.A. (and also, as appears from his advertisements, F.S.A., F.E.S., &c.), raises some objection to a late criticism in *Iron* on his aluminised bread analysis. The learned professor suggests that he could only have missed the alum if it had been ammonia-alum. Now, as there happens to be far more ammonia-alum in the market than potash-alum, it is, to say the least, singular that Mr. Gardner should prefer to employ a means which would only detect the kind he was least likely to find.

The principal point in question, however, is as to the volatilisation of sulphuric acid in preparing the ash. Any one who takes the trouble to collate the published analyses of bread, wheat, and flour-ash, will see that the phosphoric acid therein is far more than sufficient to saturate the bases present. Under these circumstances, it is simply absurd to expect sulphuric acid, if present, to remain undecomposed in such an ash after ignition. Mr. Gardner, it seems, does expect a sulphate to be stable under these conditions. It appears, then, that he has made either an important discovery or a serious mistake. I, with many others, adopt the latter conclusion; and the Polytechnic professor would have shown himself wiser and more manly by confessing his error.—I am, &c.,

THE EDITOR OF "IRON."

Dec. 9, 1873.

CONCERNING ATOMS.

To the Editor of the Chemical News.

SIR,—Your correspondent "Atom" (CHEMICAL NEWS, vol. xviii., p. 281) has stated that the existing difference of opinion amongst chemists, on the subject of Atoms, appears to arise from our incapacity to understand the meaning of "the infinitely small."

Now, with respect to space, I think a clear *positive* idea of the infinitely small is to be found in the mathematical definition of a *point* (having neither length, breadth, nor thickness). It exists in space (we may term it a *locus* in space), but has no extension, so that the addition of points (even *ad infinitum*) can never produce any finite space, however small.

I think the most determined opponent of the atomic theory will hesitate, however, before he attempts to apply the same argument to *matter*; and, if it be not applicable (that is to say, if matter must have *extension*), it appears clear that "matter cannot be divisible *ad infinitum*," which demonstrates the truth of the atomic theory, although it does not, of course, prove that in any case we have actually arrived at the ultimate division, even in theory.

With respect to "the infinitely great" it is utterly impossible to attain any *positive* idea; our nearest approximation is by a mental process of "increasing the finite without end,"—a pure negative notion; and in regard to two points we can be perfectly certain, viz. (1), that additions of the infinitely small can never produce anything finite; and (2), that additions of the finite (however large), even *ad infinitum*, cannot produce the infinitely great.

In fact, "the infinite" can never be either a multiple or sub-multiple of the finite.—I am, &c.,

HENRY HUDSON, M.D.

Glennville.

THE CHEMICAL SOCIETY'S NEW ROOMS.

To the Editor of the Chemical News.

SIR,—I am sure that such of your readers as are accustomed to attend the meetings of the Chemical Society will join with me in protesting against the bad lighting and ventilation of their new rooms.

The height to which the seats are raised, in so comparatively low a room, exposes their unfortunate occupants to a blinding glare and overpowering heat from the sun-lights overhead; and this, added to the bad state of the ventilation, renders the room dangerously unhealthy; indeed, speaking of one or two friends, I can testify to its evil effects.

The room ought to be lighted by brackets, at least at the upper end, and better ventilation provided. At all events something must be done.—I am, &c.,

VENTILATOR.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopaedic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgement. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences, November 3, 1873.

Certain Calorimetric Values and Problems.—M. Berthelot.—The author announces the agreement of the

results obtained by MM. Favre and Valson with his own. The only discrepancy, the case of borax dissolved in sulphate of ammonia, he explains by means of a double decomposition which takes place. Supersaturation he views as the slow formation of a new hydrate. Perhaps the existence and the disappearance of a great number of saline supersaturations express merely the existence and transit from one definite stage of hydration or of combination to another representing a lower degree of solubility.

Researches on the Thermic Effects accompanying the Compression of Liquids.—P. A. Favre and Laurent.—A mere preliminary notice "to take date."

New Volatile Saccharine Matter Extracted from the Caoutchouc of Madagascar.—Aimé Girard.—The author recently (Comptes Rendus, lxxvii., p. 820, and lxxviii., p. 426) described two new volatile and saccharine matters, dambonite, $C_8H_{12}O_6$, extracted from the caoutchouc of the Gaboon; and bornesite, $C_{14}H_{14}O_{12}$, obtained from the caoutchouc of Borneo. Both these, on treatment with hydracids, are split up into methylic ethers on the one hand, and into crystalline non-volatile saccharine matters on the other, possessing the composition of dried glucose. A third substance of this kind, matezite, obtained from the caoutchouc of Madagascar, is white, crystalline, very soluble in water, less so in alcohol, from which it separates in the form of laminary crystals, hard and gritty under the teeth. It fuses at $184^\circ C$. to a vitreous mass. At 200° to 210° it sublimes slowly without decomposing; the sublimate does not take the form of needles, but that of transparent drops. It consists of—

Carbon	42.3
Hydrogen	7.0
Oxygen	50.7

100.0

Its formula is $C_{20}H_{20}O_{18}$.

Preparation of Active Amylic Alcohol.—J. A. Le Bel.—There appears to exist an inactive amylic alcohol boiling at $29^\circ C$, the constitution of which is well known, and an active alcohol, having a rotatory power of about 20° for a column of 50 centimetres. The latter alcohol has been less studied on account of the difficulty of its preparation. It boils, according to Pasteur, at 27° to 28° . It is deprived of its rotatory power by repeated distillation with potash.

Influence of Certain Gases on the Preservation of Eggs.—P. Crace-Calvert.—Oxygen in a dry state has no perceptible action. If the gas is moist the egg becomes covered in three weeks or a month with a white mouldiness, consisting of *Penicillium glaucum*, or of a *Mycelium*. On breaking the egg its contents do not appear to have undergone any decomposition; though an examination of the gases in the apparatus reveals the presence of a notable quantity of carbonic acid and of a little nitrogen. If the shell is perforated with a fine needle the egg is decomposed in dry oxygen, liberating a larger quantity of nitrogen and carbonic acid. There is a little *Mycelium* on the outside of the shell, and the contents, which are putrid, contain abundance of vibrios and mycozymas. In moist oxygen the decomposition is more complete. In moist nitrogen, eggs, whether perforated or intact, may be kept for three months. If perforated, the contents are slightly decomposed; no filament of *Penicillium* can be seen, but vibrios are formed. In hydrogen the eggs are covered with a slight down, but the interior remains sound. In carbonic acid the eggs are preserved perfectly, and the shells do not show any trace of *Penicillium*. In coal-gas the results are similar.

Influence of Certain Substances upon the Preservation of Eggs.—F. Crace-Calvert.—The author plunged new-laid eggs in weak solutions, $\frac{1}{10}$ of chlorine, hypochlorite of lime, sulphate of lime, and phenic acid. Eggs in a solution of chlorine, in a stoppered bottle, remained unchanged from April 18th to December 12th

On being withdrawn from the solution and re-inserted, the bottle being left unstopped, they were found on the 19th of December covered with *Penicillium glaucum*. In chloride of lime the eggs were found covered with *Penicillium* on April 28th, which continued to increase. On June 8th, it could be seen through the shell that the yolk was displaced, and numerous filaments of *Penicillium* appeared in the interior. In lime-water the eggs became covered with *Penicillium* in twenty days, and on June 8th, other forms of mould appeared in the interior. The contents were decomposed, the white containing much *Penicillium*, and the yolk abundance of microzymas. Sulphite of lime gave the same results. The eggs plunged in phenic acid presented no change up to June 8th. They were then slightly covered with mould, but the contents were quite sound.

On Malaria.—M. L. Colin.—The author concludes that the soil plays an important part in the generation of malaria; that the ingestion of marsh-water does not produce intermittent fever; that it will be easier to discover the febriferous germs on the surface of land newly turned up than in the atmosphere of the marshes.

Analysis and Criticism of an Essay on the Constitution and Origin of the Solar System, by M. Roche.—Note by M. Faye.—M. Roche, supplementing La Place's theory, has studied the surfaces of level beyond the actual limits of atmospheres. He shows that, commencing from a certain distance, these surfaces cease to be convex towards the centre of the star. They merge into one another, and present infinite sheets, so that extending (in thought) the actual atmosphere of one of our planets to those regions of instability, the materials are no longer held by gravity to the star, but are dispersed in space along those surfaces. M. Roche deals with some difficulties attaching to La Place's theory. Saturn's rings, e.g., are half contained within the actual limit of the planet's atmosphere, that is, in a region where it would be impossible (La Place's notions being rigorously accepted) that this atmosphere, in contradiction, would have left these matters; whereas if it dilated, it might exist up to the half of their breadth. Other difficulties are the great distance of the moon from the earth, the gap between Jupiter and Mars, the multitude of asteroids (135 now known) in place of a single planet; then (coming sunwards), the formations so different from those beyond,—very dense planets with slow rotation.—M. Roche has treated such problems with the aid of a new conception. La Place, e.g., only supposed rings frequent beyond the limit where gravitation towards the sun equilibrated centrifugal force. M. Roche shows, by the discussion of his surfaces of level, that the portion of the nebulous matter liberated does not merely come from the equator, but from a superficial sheet which extends much further towards the two poles, and which tends to flow towards the equatorial opening. Now, certain parts arrive with a velocity insufficient for their circulating exteriorly; they then return to nebulousity, describing ellipses, the aphelia of which are precisely at the equatorial limit. This being premised, M. Roche points out that, through the resistance of the medium, a portion of those materials ultimately falls to the sun, restoring to it some heat, while others merely lose, by their mutual reactions, their radial velocities, but retaining for the most part their tangential velocities. This idea of interior rings rendered free, in their turn, by the progressive contraction of the generating atmosphere, supplies M. Roche with the explanation of a part of Saturn's rings forming where, according to another law, no satellite of the same density as the planet could form. M. Roche's original ideas are these: Equality of duration, at first, in the rotation and the revolution of each planetary mass; impossibility of formation of satellites so long as the solar action could maintain this equality; possibility of such formation whenever the contraction of the limiting surface of the atmosphere has reduced the directive force of the central star; formation

of interior rings at the limiting surface; condition in which a planet, or a fluid mass, may conserve its figure of equilibrium, spite of the formation of the central body. (The distance should not be below five-fourths of the quotient of the diameter of the latter divided by the cubic root of the density of the satellite). M. Faye warmly commends M. Roche's work.

Mutual Action of Voltaic Currents.—M. Bertrand.—In 1871, M. Helmholtz proposed a new formula to replace Ampère's law on the elementary action of circuits. M. Bertrand considered the new law did not correspond to any force of determinate strength and direction operating between two elements, and that it must be rejected. M. Helmholtz recognised that no force, according to his law, would represent the action of an infinitely small element on an infinitely small element; but he does not see here a decisive argument against his theory. The action of two elements is composed of a force and a couple acting on each of them, and this, in his opinion, does not involve contradiction. But (urges M. Bertrand), following out such principles to their conclusion, and calculating the moment of the couple, one finds that the force producing it must have a finite intensity. Whatever the tenacity of a wire, an infinity of forces of finite strength distributed throughout its length must produce rupture. M. Bertrand here reproduces a memoir, in which M. Helmholtz has lately, in the Berlin Academy, returned to the question; and proposes shortly to reply to it.

Verification of the Areometer of Baumé.—MM. Berthelot, Coulier, and D'Almeida.—The authors give some numerical data towards establishing the graduation of the instrument. The saline solution serving as type in the areometers was prepared by dissolving 15 parts of pure chloride of sodium in 85 parts distilled water weighed in air with brass weights (the pressure being 0.760 m. and the temperature 12°), 1 litre = 1110.57 gr. Next, as to the production of 1 litre vessels at a temperature of 12°, the authors show that the 1 litre vessels constructed at 15°, under the supposition that each contains 1000 grammes of water, weighed in air, are too large by about two-thousandths.

Observations of Solar Protuberances (continued)
During the Last Six Rotations of the Sun, from 23rd April to 2nd October, 1873; Consequences as to the Theory of Spots.—P. Secchi.—This series shows a considerable decrease in the number of eruptions. While in the first series of 1871 the number was, on an average, 14 or 15 daily, with maxima of 20 to 23, and minima which rarely descended to 10, the last rotations give an average of 8 or 9, and the maxima do not exceed 12, while the minima are 4 or 5. The spots are also less numerous. From the longitudinal distribution of protuberances, it appears that some meridians give distinct minima and others maxima. Opposite points on the east and west borders often show agreement, a diametrical distribution apparently; but these details disappear in the averages. The metallic eruptions have been few and very intermittent; one, on the 18th Sept., was very memorable, and produced a group of spots. The author finds confirmation of his theory of spots. To the statement that there appear eruptions without spots he replies—(1) That these cases are very rare; (2) that the eruptions are weak, and the (comparatively) small masses projected are immediately dispersed; (3) he has noticed that certain metals have a greater efficacy (in production of spots) than others. Thus the eruptions charged with sodium give very pronounced spots; magnesium is less efficacious, and there are often beautiful eruptions of this metal without very dark spots. The cases of spots without eruptions have not been rare, but there have been few of them on the east side. Father Secchi remarks on the sheaf form of some of the protuberances, and gives a sketch. As to the direction of protuberances, he always found, in the high latitudes, the dominant direction is towards the

poles; in low, towards the equator; the change of direction occurring at about 40° . In calm periods there is a somewhat different system of directions from what is found in periods of activity.

Report on a Memoir of M. Graeff on the Application of the Curves of Discharge to the Study of the Régime of Rivers, and to Calculation of the Effects Produced by a Multiple System of Reservoirs.—M. M. Phillips.—M. Graeff shows that the effect of a single reservoir in a neighbouring region down the stream is certain, and may be exactly estimated; that the effect of several reservoirs on the same water course is also certain, though less easy to appreciate; and, lastly, that where there are at once reservoirs on the principal watercourse and on its affluents, the uncertainties increase so much that this system is not advisable, unless in quite special cases.

Influence of Atmospheric Refraction at the Instant of Contact in the Transit of Venus.—M. Oudemans.—The author shortly criticises a note of M. Dubois, and thinks that, in any case, the influence of refraction must be less than 0.13 s.

Frigorific Effects Produced by Capillarity Combined with Evaporation; Evaporation of Sulphide of Carbon in Percuss Paper.—M. Decharme.—Reserved for translation.

Remarks on Various Practical Problems of Aerial Navigation (Extrañ).—M. de Fonville.—The author thinks it highly probable that the gas of a free balloon differs in temperature from the external air by 10° c., at least twice daily. This rupture of thermal equilibrium must limit its course to a very small number of days; independently of other disturbing causes, it would render a passage across the Atlantic impossible. Nor can the disturbance be obviated by closing the orifice of the balloon with a hermetic valve. A small balloon of transparent caoutchouc explodes loudly when merely pierced with a pin; this is due to the surprising rapidity with which the membrane is rent, although the pressure of the hydrogen does not greatly exceed that which would obtain within a large free balloon, where it might be sought to neutralise the effects of the solar dilatation. Nor would the greater resistance of envelope obviate the disaster. M. de Fonville also remarks on the despatching of pigeons from balloons at regular intervals, on the disastrous voyage of Mountain and Bailey, and other topics.

Note on the Best Dimensions to give to Electromagnets.—M. du Moncel.—The writer constructs a formula from which flow some important conclusions; more especially (1) that for resistance of equal circuits, the diameters of an electro-magnet should be proportional to the electromotive forces; (2) for equal electromotive forces, the diameters should be in inverse proportion to the square root of the resistance of the exterior circuit, including the resistance of the battery.

On the Recent Eruption of Nisiro.—M. Gorceix.

Bulletin de la Société Française de Photographie,
No 10. 1873.

This number contains a continuation of M. A. De Constant's paper on the dry collodion process.

Modification of the Collodio-Bromide of Silver.—J. F. Plücker.—The author remarks that this process is the most simple known, and yields results as good as, if not better than, those of the iodide and the silver bath. It has, besides, the advantage of rapidity in the preparation of sensitive surfaces, and that of avoiding the use of a costly solution of nitrate of silver. The development of the image is very regular. The sensibility in respect to objects which reflect abundance of chemical rays is the same as that of surfaces of iodide and iodo-bromide of silver, but it is greater for feeble rays such as those issuing from verdure-shaded parts, &c.

Preparation of the Bromised Collodion.—Dissolve in 100 c.c. of alcohol 2 grammes of bromide of cadmium and 0.5 gramme bromide of ammonium; add to the mixture 2.5 grammes of papyroxyl (paper converted into nitro-cellulose) and 150 c.c. of sulphuric ether. Introduce into the solution 0.8 gramme of yellow gum-lac in scales, which is dissolved by the aid of the water-bath. Finally, 4 drops of pure nitric acid are added. After resting from two to three weeks, the collodion is ready for use. To render this collodion sensitive, an hour before the layer is required, the following solution of nitrate of silver is required. Put into a test-tube of about 12 centimetres long and 15 millimetres in diameter, 1 gramme of crystallised nitrate of silver in fine powder, and 4 c.c. of rectified alcohol, to which 1 drop of distilled water is added. The mixture is carefully heated till the nitrate is dissolved, and the solution is immediately poured into 50 c.c. of the above described collodion decanted previously into a small wide-mouthed flask. This operation is performed in the dark. It is well shaken for some seconds, let settle for an hour, and the emulsion decanted into a second bottle. The plates are covered with the collodion thus prepared, the excess being each time allowed to flow back into the bottle. The prepared plates are washed with rain-water, so that they may be quite free from undecomposed nitrate of silver, and are then set to dry, or before drying they may be coated over with some preservative, such as tannin, dextrin, acetate of morphia. The backs of the plates should be covered with some black or yellow colour. **Development.**—After having softened the sensitive layer by the aid of a mixture of equal parts of ether and alcohol, the quantity of water necessary to cover the plate is put in a developing glass, and a few drops are added of an alcoholic solution of pyrogallol acid containing 15 per cent, and a drop of an aqueous solution of carbonate of ammonia of 10 per cent.

Process for Preventing Solutions of Gum-Arabic from Moulding.—M. Hirschberg.—A little concentrated sulphuric acid is added, which precipitates the lime present. Solutions treated in this manner have been kept for eighteen months without losing their adhesiveness, or growing mouldy.

The bulk of the papers in this number are from English sources.

NOTES AND QUERIES.

Cigar Ash.—In the analyses of cigar ash by A. Percy Smith, F.C.S., in the *CHEMICAL NEWS*, vol. xxviii., p. 261, the component parts represent only 94.236, instead of 100.000 as stated.—W. SIMMONDS.

Insoluble Gelatin.—In the *CHEMICAL NEWS*, vol. xxviii., p. 109, there is a short paragraph on the power of biechromate of potash to make gum, gelatin, &c., insoluble. Can you inform me where I can ascertain particulars as to the mode of procedure, quantities to be used, &c.?—JAMES BARCLAY.

MEETINGS FOR THE WEEK.

MONDAY, Dec. 15.—Medical, 8.
TUESDAY, 16.—Philosophical, 8.
—Anthropological, 8.
WEDNESDAY, 17.—Society of Arts, 8.
—London Institution, 7.
—Geological, 8.
—Meteorological, 7.

THURSDAY, 18.—Zoological, 4.
—Royal, 8.
—Philosophical Club, 6.

Chemical, S. W. C. Roberts, "On the Preparation of Standard Trial Plates to be used in Verifying the Composition of Coinage;" R. Schenck, "On a New Compound of Nickel and Phosphorus;" Dr. Gladstone and A. Tribe, "Researches on the Action of the Copper-Zinc Couple on Organic Bodies;" No. IV., "On Allyl Iodide."

THE CHEMICAL NEWS.

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ON A NEW METHOD FOR PRODUCING THE ANHYDROUS CHLORIDES OF ALUMINIUM AND OTHER METALS.

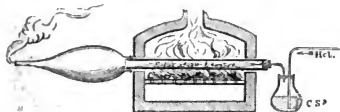
By PAUL CURIE.

THE only published process for the production of aluminium chloride is the well-known method of sending chlorine through a mixture of pure alumina and charcoal, heated to redness. The following is, I believe, a simpler method, which might perhaps, in many respects, prove economical for the manufacture of aluminium, as it does not require the use of pure alumina, nor the preliminary calcination of the same with charcoal. This process is based on the transformation of alumina into sulphide of aluminium, and subsequently of the sulphide into chloride, which two operations are condensed into one by the means hereafter described.

Sulphide of Aluminium.—This is obtained by heating alumina in a tube or retort, through which are sent vapours of bisulphide of carbon, the reaction which takes place being expressed thus:—



Sulphide of aluminium then remains in the tube or retort. The gases which escape are mostly COS, though a portion of that oxysulphide of carbon is decomposed on account of the too great heat; there is therefore, also, a certain quantity of sulphur and of CO.



Sulphide of aluminium is not easily converted into chloride, as might be thought, by double decomposition with the chlorides of other metals: thus, with NaCl only a very small quantity of chloride of aluminium is produced; with CaCl₂, MgCl₂, none at all; with KCl it forms a volatile compound, containing KCl, KS₂, Al₂S₃, and Al₂Cl₃; but by hydrochloric gas, HCl, the chloride of aluminium is readily produced.

To effect the conversion of alumina into chloride of aluminium, by a single operation, this is how I proceed:—The alumina is placed in a porcelain or earthen tube, and heated to redness. As soon as all the water is expelled from the alumina, the tube is connected at one end with a receiver, and at the other end with a tube, bringing in a mixture of hydrochloric gas and sulphide of carbon vapours. By merely sending the HCl gas through the liquid CS₂, it is so thoroughly saturated with it that it is not necessary to apply heat to the latter. A double reaction takes place simultaneously, and chloride of aluminium distils at once, mixed up with a certain quantity of sulphur and impregnated with HS. The aluminium chloride is afterwards re-distilled with iron filings, so as to free it from the sulphur and other impurities.

This process can be easily adapted to the production of all or any of the other metallic protochlorides. I have succeeded equally well in forming magnesium and chromium chlorides.

In order to make a pure aluminium chloride, as I have already stated, it is not necessary to use pure alumina.

Ordinary clay will succeed just as well: in that case the chloride of silicon, which is formed at the same time, escapes as a gas, and the other chlorides formed,—such as those of iron, calcium, &c.,—being less volatile than that of aluminium, remain in the tube or retort.

ANALYSES OF TEAS.

By A. S. WILSON.

THE following analyses, made recently, may be useful for comparison. The first seven samples are shipments of last season's teas, and were received direct from the importers. The microscopic examination showed that they were all genuine, although the leaves presented very different appearances, those of the Pekoe being small and thin, whilst those of the Assam were large and thick. Sample No. 10 was ordinary black tea, as retailed, and consisted probably of Moning with a small admixture of Assam and Pekoe. No. 8 represents an Assam green tea, of very fine quality and quite free from facing. No. 9 is China green tea, "faced," but otherwise of fine quality. The facing consists of steatite, or some other magnesian silicate, and turmeric, with an exceedingly minute quantity of Prussian blue.

Several persons have been prosecuted, under the Adulteration Act, for selling faced tea: the result has been that green tea has deteriorated in value, if, indeed, it has not been completely driven from the market.

At a recent prosecution case, in Glasgow, the city analyst stated in his evidence that this tea (No. 9) contained 3 per cent of adventitious substances, but this could only have been intended as an approximation, since there is no means of estimating the quantity of turmeric. In giving evidence for the defence, Dr. Wallace stated that the quantity of Prussian blue did not exceed a tenth of a grain in an ounce of tea; and as green tea is only used for mixing with black, and seldom to the extent of more than 10 per cent, it follows that an individual is not likely to consume at one time—even supposing the whole of the pigment to become suspended in the infusion—more than the two-hundredth part of a grain of Prussian blue. It was further argued for the defence that, as the added ingredients are not poisonous, and are evidently not introduced for the purpose of adding weight (since the quantity would not pay the expense of the manipulation), the case was not an offence under the Adulteration Act. The vendor, however, was fined for selling it, and fines have been imposed on several others since then for the sale of tea of a similar kind.

In the following table A represents the percentage of ash; B, the proportion of the ash soluble in water; C, that soluble in hydrochloric acid; D, the siliceous matters; and E, the amount of peroxide of iron in the ash.

	A.	B.	C.	D.	E.
1. Moning	6.00	3.15	2.03	0.82	0.05
2. "	5.82	2.73	2.52	0.57	0.07
3. "	5.90	2.76	2.36	0.78	0.07
4. "	5.55	2.66	2.21	0.65	0.09
5. Kaisow	5.43	3.33	1.88	0.22	0.09
6. Foochow Pekoe ..	6.15	3.20	2.16	0.79	0.09
7. Assam Souchow ..	5.15	2.90	2.05	0.20	0.03
8. Green Assam ..	5.32	2.94	2.11	0.27	0.08
9. Fine Green tea, faced	7.14	2.38	3.19	1.57	0.12
10. Black tea, mixed ..	5.68	2.86	2.33	0.49	0.04

Perkin and Son.—We understand there has been recently a movement on foot for converting the concern of Perkin and Son, the great patentees and manufacturers of alizarin, at Sudbury, into a Limited Liability, with a paid-up capital of £200,000. We learn, however, that the entire business and patents have just been purchased for a very large sum by Brooke, Simpson, and Spiller, the well-known London manufacturers of aniline colours.

ON HEAT.*

By FREDERICK GUTHRIE, D.A., F.R.S., &c.

The points treated of in this Lecture were—"Conduction and Convection; Capacity for Heat; Heat Quantity; Specific Heat."

With regard to the passage of heat through space, it does so in three ways—by conduction, by convection, and by radiation. A candle and an ordinary pin may illustrate these. When the pin is held in the flame of the candle quite steadily, both are at rest, but the heat gradually creeps along the pin from end to end; that is the conduction of heat. When the candle is moved from one place to another, the heat travels with the hot body, just as in the flight of a red-hot cannon-ball; that is the convection of heat. When the hand is placed by the side of the candle, it gets hot, because the heat is radiated from the candle in all directions, striking surrounding bodies and heating them; that is radiant heat, and the most prominent example in Nature is the sun.

Examining different bodies as to their conduction of heat, we find that the metals exhibit an extraordinary pre-eminence in their power of conducting heat. As a class, solids conduct heat better than liquids, and liquids better than gases.

Amongst solids, the metals conduct heat best, as can be simply shown. A compound cylinder of brass and wood is wrapped round by a piece of paper, which is heated at the junction of the two solids. The paper is scorched on the side of the wood, but is unscorched on the side of the metal, because the brass conveys away the heat from the paper so quickly that the paper is kept comparatively cool. The sensation of heat very much depends on the nature of the substance with which the hand is in contact. Thus, a piece of brass and a piece of wood exposed to the heat of the sun for an equal time give nearly the same temperature with a thermometer; if anything, the wood is hottest; but test them by the hand, and the metal appears to be the hottest. Why? If the brass be hotter than my hand at the point of contact, there is an equalisation of temperature, the brass gives heat to the fingers, and that heat withdrawn is instantly replaced by heat from other points of the brass, so a constant supply is sent into the hand; whereas, the hand in contact with the equally hot wood withdraws heat, but that heat is not supplied from the neighbouring portions of the wood, and it is not poured into the hand. In the case of the metal, the hand really receives more heat in the same time.

There is one important practical application of the conduction of heat by metals to be noticed. Take a ring of copper, and pass it over a lighted match or wick of a candle, and, although it does not touch them, the flame goes out. For gas to burn in contact with the air, a certain heat is necessary for the combustion of the hydrocarbons; if, therefore, by contact with a metal, the temperature is reduced below that necessary for their union, the flame goes out. Here is a mixture of coal-gas and air burning in the ordinary way, and if we introduce between the source of heat and these mixed gases a metal wire gauze, then it happens that the gas burns above the gauze, but the flame does not strike through. The gases are too much cooled beneath, in contact with the gauze, for their combustion to be possible, neither can the flame strike back, for, in passing through the meshes of the gauze, the gases are too cool for combustion, the heat being radiated by the fine meshes into space. [The lecturer here took a piece of wire gauze, and bent it round in semi-cylindrical form, having the source of light in the inside, and the source of combustion, or the mixed gases, outside, the light inside the gauze not striking through. This semi-cylinder of gauze was next bent completely round, still enclosing the light, and the gases outside did not burn.] That is the principle of the Davy lamp.

Copper conducts heat better than iron, as seen in heating rods of the two at the plane of contact, and noting the melting of fragments of wax arranged along the two. That silver conducts heat better than platinum is indirectly proved by heating a compound wire of the two metals by an electric current; the silver remains dull and comparatively cold, while the platinum, no thicker than the silver, gets red-hot.

Between the conducting power of liquids and that of solids, there is such a wide gap that the two groups have not been linked together. In the first place, let us see that liquids are bad conductors. Take some ice in a test-tube, putting a little fragment of copper wire on the top to keep it down, then pour hot water above it, and the hot water can be actually boiled without melting the ice, showing that the water has not been able to carry down the heat. Yet water, of all liquids, excepting molten metals like mercury, stands at the head, having the greatest conductivity, or the least thermal resistance. The conducting power of liquids is measured by heating the upper surface of a film of liquid, and noting the expansion of air in a chamber upon whose upper side the liquid film rests. The more complex the composition of a liquid is, the more opposition does it present to the passage of heat by conduction, and liquids containing halogens also resist the passage of heat.

That gases have very small conducting power is familiar to all of us in everyday life. The imperfect conduction of many solids is due to the gases, generally air, which they enclose in their pores or between their fibres, and hence clothing protects the body from loss of heat in cold weather, and from the scorching heat of the sun in hot weather. The double windows used in cold countries, the fire to keep in the heat of the body in cold weather, and the turban used in hot countries for keeping out the heat of the sun, are all examples of the practical application of the bad conduction of gases. A red-hot ball may be carried in the hand if a mass of asbestos is interposed, because the air entangled in its pores refuses almost perfectly to conduct heat. Hydrogen conducts heat far better than other gases, and accordingly cools bodies in contact with it with greater rapidity, but some say this is due to the nimbleness of motion of its parts, and that the cooling effect is due to convection.

We come now to the mode in which heat travels by convection; and as solids, as long as they remain solid, cannot have any molecular motion of this kind, there are only two examples—the convection of liquids and gases.

A fluid is a fluid on account of the facility with which its parts move amongst one another. Since liquids expand when heated, it is clear that a mass of hot liquid in the bosom of a cold liquid of the same kind must tend to rise. Accordingly, we find if we heat a mass of liquid on one side, currents are established on the side which is heated. Perhaps the best illustration of this was given by taking the source of heat itself in the bosom of a liquid, and showing its effect on the screen by the lime-light. A spiral of platinum in water has a current of electricity passed through it, which heats the wire, and streams of water rise upward from the platinum. But Nature presents us with phenomena, based on this relation between hot water and cold, on a vaster scale. It is found that the ocean is traversed by enormous currents, tending in our hemisphere from the south to the north, and having an easterly direction. The great type of this current may be called the Gulf Stream, and it is as vain to talk about its beginning as that of an india-rubber band. There is circulation throughout, and the motion is carried on continuously. The causes of the Gulf Stream, as considered independent of its source, have been variously traced. It has been said that heat plays upon the Equator more than it does upon the Poles, and that is mathematically true, for at the Poles the heat strikes more obliquely. That is the prime reason why the Polar regions are colder than the Equatorial. Then it has been said that, this being

* Abstract of the third of a course of Lectures to Working Men, delivered in the South Kensington Museum on Monday, the 1st inst.

the case, the earth at the Equator, getting more heat than at the Poles, gives its heat more abundantly to the water, and swells the water, and that swollen water is carried to the Poles: there is something illogical in this, because the swollen water is not heavier than the unswollen water. Then the explanation has been given that it is owing to the prevailing winds at the Equator. But, speaking under correction, I imagine that the origin of the Gulf Stream is rather to be looked for at the Poles than at the Equator. When water freezes it gets lighter: a quantity of water freezing at the Poles has the result of a lifting of water above the water, and the leaving of a quantity of brine, the same temperature as the ice at the moment of freezing, but denser. The heavy brine therefore sinks, and travels from the Pole to the Equator beneath the general mass of the water, and this current has to be compensated for by the travelling of warm water at the surface from the Equator to the Poles, which finally encounters and melts the ice-floes moving in the opposite direction. Thus, modified by the winds, and guided by the contour of continents, it tempers our climates so materially and, for us, so essentially, having for a return current that current at the base of the ocean which we seldom can recognise but by the deepest plumbing.

With regard to the conduction of heat by gases the whole system of ventilation depends upon it, and also upon the elementary fact that all gases swell by heat, and therefore, if a hot mass of gas is imbedded in a cold mass of the same gas, it has a tendency to rise.

And now we come to a point which requires considerable power of abstract reasoning to see it clearly, and therefore the simplest illustrations possible will be used. Different substances have different capacities for heat, *i.e.*, if we take equal weights of two different substances at the same temperature, and put the same quantity of heat into each, we shall find them in most cases to be unequally heated; or, if we take the same quantity of heat out of each, the one which was before heated most is now cooled most. We may aptly compare the capacities of different bodies for heat with the capacities of different cylindrical vessels for water, comparing the temperature with the liquid levels. Thus, the level of the water in a wide cylinder will be less affected by the addition or withdrawal of a given quantity of water than the level in a narrow cylinder. Four metals—Fe, Cu, Zn, Bi—are all taken from the same oil-bath, and placed upon the same sheet of wax. The melting power of Bi will be represented by the cylinder having the less capacity for water.

There is, therefore, a most important difference to be observed between the quantity of heat in a body and the temperature of a body. The quantity of heat is measured by the heat-unit, which is generally considered as the quantity of heat which will raise 1 gm. of water at 0° C. to 1° C. It is found experimentally that if a hot body be added to heat 1000 grms. of water 1° C., it will heat 500 grms. 2° C., and so on, proving that the capacity for heat of water is nearly the same at all temperatures.

The ratio between the capacity for heat of one body and the capacity of an equal weight of another body is the specific heat of the first compared with the second. Water is the substance generally taken as having the standard or unit capacity for solids and liquids. Suppose, then, we plunge 1 lb. of a metal at 100° C. into 1 lb. of water at 0° C., and find that the resulting temperature is 12° C., we know that the 1 lb. of metal in falling 88° C. has raised the 1 lb. of water 12° C. The capacity of water is therefore greater than that of the metal, in the proportion of 88 to 12, or the specific heat of the metal is $\frac{12}{88}$, or about 0.14. It must be well borne in mind that specific heat is not heat at all, but number—number got by comparison, or division, just like specific gravity. Further, that it is, like specific gravity, independent of the quantity or individuality of the matter under consideration. We are obliged to operate with a certain size and weight of any substance, say copper, but we obtain the specific heat of all pieces of copper—of copper in the abstract,

ON THE ENERGIES OF THE IMPONDERABLES, WITH ESPECIAL REFERENCE TO THE MEASUREMENT AND UTILISATION OF THEM.*

By the Rev. ARTHUR RIGG, M.A.

(Continued from page 257.)

SIR H. DAVY, in an article "On the Causes of the Colours of Organic Beings," written about 1790, when Davy was only 19 years of age, writes—"Nature has catenated together organic beings, and made them mutually dependent on each other for their existence, and all dependent on light. A privation of light would be immediately destructive to organic existence; vegetation would cease; the supply of oxygen gas would be immediately cut off from animals; the lower strata of the atmosphere would become composed of carbonic acid; and perception and volition would exist no longer."† Although these views were expressed more than eighty years ago, very little progress has been made in the direction they indicate.

Such considerations as these suggest that he who would truly ascertain and measure the energy of light—that energy upon which all terrestrial life depends—must look to do so in its influence on organised beings; he must either separate the allied influences, or he must so separately estimate these that he can apply his estimate correcting a general result by a process of common occurrence—*viz.*, the eliminating of all foreign or allied energies, and thus give to science the true energy of true light. He who, with knowledge and patient skill, enters upon this hitherto almost unexplored and yet noble field of investigation and research, will give to the age in which he lives, and transmit to future generations, that which will indeed be a boon to all. Pending the coming of that time when some science investigator, possessed of sufficient knowledge, humility, originality, and skill, shall do for light what Newton, Atwood, and Kater have done for the measuring of the energy of gravity—what Mayer, Joule, and Thompson have done for that of heat—what Haughton has done for that of vitality, and what Siemens, Matthieson, Jenkins, and others have done for electricity—what Davy, Dalton, and others have very partially done for that of affinity, and what Bunsen and Roscoe have done for the chemical energy of light—but what no one has yet done for that of light, properly and exclusively so called—we must content ourselves with such modes of estimating this energy as are at present known and available.

This energy is supposed to be manifested in the promotion and facilitating of chemical affinities. These affinities (as doubtless some present remember) vary in their character as one or more of the "imponderables" are combined in their promotion. So much is this the case that chemical notation now adds, in reference to certain indicated changes, the words, by heat or electricity, as the case may be. There are, however, certain affinities called forth under the influences of light which do not show themselves under any other conditions. As, for example, certain of the salts of silver (such as silver combined with chlorine, iodine, or bromine) change their colour and their character, the silver being set free from its combination as a black powder. There is also that power, which plants in the presence of sunlight possess, of changing the carbonic acid gas, which, if allowed to accumulate in the atmosphere, would soon render it unfit to be breathed, into its constituent elements, the plant retaining the carbon and ejecting the oxygen. Priestly, in 1790, that is, at the period when Davy wrote the article from which an extract has been read, a period when, for a short time, men's minds were being directed to this department of scientific research, was the first to show that plants kept the atmosphere pure and healthy, but he

* The Cantor Lectures, delivered before the Society of Arts.

† Davy's Works, vol. ii., p. 206.

could not calculate. His was rather a qualitative, and not a quantitative result.

Changes in the colour of salts of silver, through some energy of light, have been observed since the middle of the sixteenth century. In 1777, Scheele suggested some explanations which, although very imperfect, are as yet the only recognised ones. In the early part of the present century experiments of a similar kind were made at the Royal Institution by Wedgwood and Davy.* The absence of any mode of fixing the impression caused the results to be very evanescent, but the localising of this peculiar property of light is clearly announced in these words:—"Red rays, or the common sunbeam, passed through red glass, have very little action; yellow and green are more efficacious, but blue and violet light produce the most decided effect."

The rapid development of the art of photography during the past twenty or thirty years has led enthusiasts in this branch to overlook the purely chemical character of their art, and to attribute the changes with which they deal to a manifestation of the energy of light. Hence scales have been devised which may enable photographers to adopt some kind of a standard. They are not, however, worthy of the name of scales of energy, as they depend upon the power of the eye to appreciate very slight differences in shade. A scale or measure, to be of general use, should be of such a character that a person in one part of the world writing to one in another might refer to some common standard.

There is, however, a process for obtaining a measurement of one element in the energy of light capable of greater accuracy of observation than the photographic one. This also is chemical.

In the lecture on the energy of affinity a brief time was devoted to the peculiar manifestation of affinities under the conditions of the nascent state.

It is apparently a deviation from this form of energy when the two well-known gases, chlorine and hydrogen, are produced and intimately mixed, either in their nascent state or afterwards, in the dark or in the presence of that portion of the solar beam we call red. Under these conditions no rapid union of the gases takes place. Permit the evolution or the mixing of the two gases to be in ordinary light, properly so-called, and an intimate union, or rather an actual chemical combination, is a consequence.

If these gases be separately produced and collected in a glass vessel in equal parts, the union and formation of a new chemical compound in this glass vessel follows from exposure to light. If the light, or rather that particular portion of the solar beam to which chemical action is generally attributed, be permitted to act upon the two mixed gases, then the union takes place at a rate determined by the energy of some one or more of these constituent elements of light on which the combination depends. Where in the solar beam these constituents are is a question easily solved.

Every ray, or every portion of a beam of light, is capable of producing union between hydrogen and chlorine; but the combination takes place at very different rates, according to the portion of the beam which acts upon the united gases. The actinic portion will act seven hundred times as rapidly as the heat portion. That is to say, a certain combination will take place under the influence of this portion in one minute, which it will take more than eleven hours to accomplish under the influence of the heat portion. Therefore, by separating the ray of light, we can graduate the rate at which the combination occurs. Here are some glass bulbs containing chlorine and hydrogen which have never yet been exposed to the light. If one of these be placed under this globe of red glass, then the light that passes through it will be the portion of light corresponding to the heat end of the spectrum, and it will take hours to accomplish the perfect union of these two gases. If, however, one be placed under a globe of a blue colour, the light falling upon it will represent that belonging to the actinic portion of the spectrum, and the

gases will unite (if the experiment be successful), and explode in about ten seconds.

Whilst recognising this test and measuring gauge of the chemical brightness of certain lights, it must be borne in mind that it is chemical action, and not the energy, of light, properly so-called, that is measured. For instance, when the brightness of the sun's disc, as a case of light-brightness, is 520 times that of magnesium wire, the chemical brightness has been found to be not forty times as great.

Here are diagrams of two spectra, one of which is obtained from flint-glass. Now, flint-glass produces an effect which is considered to be due more to the physical property of density than to the elements of which it is chemically formed. Assume this diagram to be a faithful reproduction of the spectrum from flint-glass. Now, however similar another glass may be in appearance, yet if it differ in density and constituent elements the distances between certain lines in the spectrum may in some portions be the same, but in others they will differ. If, therefore, light be estimated from the spectral appearance of it after it has passed through any substance, it is clearly subject to the influence of that substance. Again, on another diagram is a series of colours produced by a process called diffraction. This is the apparatus, and this is the mode of producing those colours. At the object-glass end of the telescope there are a number of very fine lines drawn, and if the telescope be directed to a very intense speck of light, such as the reflected sun from a small silvered globe or the bulb of a thermometer, coloured bands are seen, containing the same colours that the flint glass spectrum shows. But the colours seen under this diffraction arrangement are very different in quantity to those seen under any other arrangement. A diffraction experiment is easily made by each for himself. From that hook a bright reflecting silvered glass globe is suspended, and two or three smaller ones of the same kind. If anyone is tired of listening, and feels disposed to go to sleep, they can perform this experiment very easily. Just close your eyes and allow the eyelash to interfere with that speck of light reflected from the globe, and you will probably see colours radiating on both sides. Those are colours due to diffraction, and there are modes by which they can be made to appear much wider apart than by the one now described. Taking the diffraction spectrum, we find that these distances, from D to E, say of a yellow portion of the spectrum, are not of the same length as the corresponding portion in the flint glass spectrum, and the same with the other portions, so that the proportions are quite altered. This is called the "irrationality" of the spectrum. Line D there becomes the middle of the spectrum instead of being, as it is here, very near to one end. The consequence is, when we talk of there being no heat in this portion of the spectrum, we have really and truly distributed the heat which ought to be condensed in F, G, over that large space, and therefore it shows on a fixed area much less heat than it would do not so distributed. If, now, these apparently unequal halves of the spectrum be examined for heat, it will be found that collecting them into two separate foci, the heat in the one focus is equal to that in the other. Clearly, had these portions been examined over equal areas the heats would not have been equal. Therefore the notion generally entertained of heat being confined solely to one end of the spectrum is not strictly true. That diffraction spectrum explains it, and there are other matters bearing upon it which, if time permit, shall be referred to presently.

That kinetic energy, of a character as important as any found in the other imponderables, exists in light, may be inferred from the fact that, if light be extinguished by falling upon such a surface as lamp-black, the stoppage of the ray—the consequent absorption of it—produces heat. The motion of the light has been converted into a motion called heat. If, however, the light be stopped by some of the salts of silver, then this

* *Journal of the Royal Institution for 1802, p. 170.*

motion is converted into chemical changes. The heat and the change are consequences of an energy in light. Nor is it only when influencing different substances that light effects different results. Take, for example, carbon, and note how varied is its behaviour towards light and electricity. When in the form of a diamond, then carbon transmits light and stops electricity; but when in the form of coke, into which the diamond is transformed by heat, then carbon transmits electricity, but stops light. No cause has yet been assigned to that which seems almost universally the case, viz., transparent bodies stop electricity—carbon, the metals and opaque bodies, stop light.

It is a popular opinion that sunlight or sun-brightness extinguishes household fires. May not this be from some hitherto undiscovered energy of solar light, for it is not the heat of the solar beam which thus causes the carbonaceous fuel in our grates to become dim? If the energy of light is to be studied, and its value to be estimated and brought within our powers of utilisation, it must be done through agencies widely different from those hitherto named. Looking at the order of creation, and watching the behaviour both of the animal and vegetable kingdoms, it seems that through them must be had our knowledge. Allusion has been already made to these. It may be well to investigate more closely the relation of the energy of light to them. No mode of measuring the energy of light in relation to animal life has been suggested, and yet its energy in this respect is more strikingly extraordinary than that of the other imponderables. Take one illustration only. When you knock at the door of a friend's bedroom, and receive no answer, how loud, and louder still, becomes the rap ere he awakes. How often are stories told at the breakfast-table of night noises unheard and unheeded by those asleep. Let but a beam of sun-light, or even candle-light, shine on the closed eyelid, and by some mysterious energy on the well-covered retina the sleeper awakes.

The worlds of animal and vegetable life awake and work mainly in consequence of some such hitherto unmeasured energy of light as that now alluded to.

Turn to vegetable life. With respect to this, Professor Helmholtz remarks:—"Take a seed, then look at the tree, and consider from what source has been derived all the material of the tree. Burn the seed, burn the tree, whence comes the different amounts of heat? Chemistry tells us that the heat is produced from carbon, oxygen, and hydrogen; these are derived from carbonic acid and water. Plants cannot obtain these except under the influence of solar light."

After plants have utilised the light it is not useable again for the same purpose. Take two screens of dark paper, such as these, with holes in them—say half an inch in diameter—one hole covered with letter-paper, the other covered with a green leaf; put pieces of photographic paper behind them, and expose to day-light or magnesium light. Beneath the letter-paper is a dark spot—an image of the hole; beneath the leaf is no discolouration. The leaf has utilised the light, the letter paper has not. The energy of that which passes through the leaf is spent, of that passing through the paper is not spent.

Although in plants a variety of operations take place, which must in some way unknown to us store up a large amount of energy, and although there is to all practical purposes no heat developed, yet we know well that there are thus stored up chemical tensions which give out their true physical value in heat and mechanical work, as the tissues of the plants are destroyed by a process of animal or other combustion. We are as yet quite at a loss to know how the plants do this, or by what elements in light, properly so called, it can be so completely and perfectly done.

Sir John F. W. Herschel, in a paper in the *Philosophical Transactions* for 1842, gives a most interesting account of

* Helmholtz, *Medical Times*, 30th April, 1864, p. 473.

an extended series of experiments on the action of the solar spectrum on vegetable colours. He operated upon the juices of the leaves, and also upon some of the resinous compounds of plants, and his conclusions have since been confirmed, viz., the action of the solar spectrum is confined to the visible region of it. The chemical or actinic rays act with chief energy upon silver or inorganic compounds, but are, for the most part, powerless upon vegetable colours: so also are the heat rays, or those below the extreme red. Thus Sir J. Herschel, in 1842, separated by a very broad line the luminous portion of the solar beam from the other parts of it. That the energy of the luminous portion of the solar beam is requisite ere plants can exercise their vital functions is well known to all who have made any of the experiments which show the extent to which, under the influence of that energy, plants can effect chemical changes. These changes take place most abundantly in the yellow, or in what our eyes would call the brightest, portion of the spectrum.

The energy of this luminous portion may be gathered from experiments made during the last few years by an American. Flowering plants were placed in different colours of the spectrum, and it was soon observed that their action upon carbonic acid gas depended upon the colour of the spectrum. He took a flower, and under the action of a red ray he did not get 1 cubic inch of gas off, but only 0.33 of an inch. As soon as he submitted that same plant to the orange ray, he got 20 cubic inches, and from the yellow he got 36 inches. But when the same plant was put under green, blue, indigo, or violet, he could not get the plants to act at all in the purification of carbonic acid gas, thereby showing pretty clearly the energy of light in the luminous portion of the spectrum as regards growing plants.

The decomposition, then, of the carbonic acid is effected chiefly by the energy resident in what may be called the yellow rays. It is a somewhat noteworthy coincidence, that the eye generally fixes upon the yellow portion of the spectrum as that possessed of the greatest brilliancy; it is also noteworthy that the spectroscopist reveals that in the atmosphere (viz., sodium) which, on being burnt, always produces a yellow band. It is, to say the least, curious that we cannot get heat by combustion in the air without the production of this yellow light.

It seems, then, that plants and human eyes are most sensitive to the same portion of the solar beam, and this portion is in light properly so called. May it not be that yellow light is most acceptable to the plant, and most impressive upon us, because carbon is in both cases involved—the retina of the eye being a carbonaceous compound? Had the retina been a salt of silver, then the greatest brilliancy would perhaps have seemed to be in the blue rays.

This identity in composition between the plant and that part of the animal on which light exercises its chief energy, suggests that in the influence of light on plants (whatever that may be) must be sought the data from which to deduce a mechanical rather than a chemical measure of the energy of true light.

The contrast of this energy in its effect upon the metal salts and plants is especially marked as regards time. On the metal salts it may be said to be instantaneous, but on the gums and resins of plants exposure for days and months to clear sunshine is needed to produce any marked action. A patient watching and building up on such scant data as may hitherto have accumulated will some day produce the dynamical equivalent of light.

There is one experiment here which will probably bear out what has been said. You are probably aware that plants, by receiving light, manufacture what we name colour. They manufacture the green material out of which the leaves and the general character of the plant is formed, and that green material is called "chlorophyll." This vessel consists of two beakers with the bottoms cut off, one about an inch and a

half larger than the other. The glass cylinders then left are fixed with marine glue in a wooden ring. The space between them is filled with a solution of chlorophyll, obtained by steeping for forty-eight hours common parsley in any cheap spirit, such as methylated alcohol, and then filtering. It therefore contains the green colouring matter of leaves. This green colouring matter has been made almost exclusively by the yellow portion of light, and not at all by the chemical portion, and, with a view to show this, we must refer to the spectroscopic view, namely, that chlorophyll, being really manufactured by yellow light, is practically saturated with yellow, and can take up no more. Thus, if a vessel containing a saturated solution of salt had a piece of salt dropped into it, that piece would not dissolve. If, now, there be placed inside this chlorophyll solution anything that produces these other coloured rays, we shall probably find that, while sensitive to the one colour, the solution will not be to the other. Here is some lithium, which shall be placed on a little piece of platinum wire and burnt, so causing a beautiful red flame. On putting the flame within the hollow cylinder containing the chlorophyll, you will see the yellow beam alone can pass through the green solution. The green solution having been made with that yellow beam, is thoroughly saturated with it, and can take up no more, but it can take up the other coloured rays, and therefore they do not pass through. In that portion of the flame rising above the green solution you see the red-coloured flame. Thus the yellow colour is consequent upon the saturated solution of chlorophyll, and therefore nothing but yellow can come through. The absorption of this yellow portion of the solar spectrum, by the vital energy of the plant and utilising the same in its composition, might have been inferentially suspected from the fact that leaves become yellow in the autumn, thus restoring in their death what, for want of a better term, we must call "the colour" they had absorbed in their life. The yellow colouring matter of the autumnal leaf is called "xanthophyll." Probably, as "chlorophyll" and "xanthophyll" are more examined and known, so the energy of light may be more appreciated and measured.

This examination of light, properly so-called, has led to another contribution towards an estimate of the energy. That plants grown in the dark are drawn to any crevice through which light enters has long been known. But it has not been so often observed that young plants bend the stems to the indigo portion of the spectrum, i.e., if grown in red, or yellow, or green, they bend in one direction, but if in the violet, then in another direction. They recover the vertical position in darkness. May it not be that the energy in the indigo of the sky produces the vertical character of stem?

Thus light properly produces motion, and so assimilates itself to heat and electricity. The complementary colours of red and green (see the chromatic circle of Newton on diagram) are those which represent the relation of colour between the animal and vegetable kingdom. Plants reject green and absorb its complementary (red). The blood of animals is red, therefore animals should have green supplied in the fields and in our furniture.

That this energy of light is utilised in vegetation, and that practically we recognise it, may be noted in the ingenious modes by which in our small gardens we try to imitate nature. The nailing of branches on walls—an advance on this in espaliers on lattice woodwork, and the still more recent practice of cutting out the inner branches of orchard apple trees; also training others to hang in umbrella fashion, or the splaying of gooseberry bushes as funnels, all these are devices to permit of the more universal exercise of this unmeasured energy of light.

Light influences the colour of animals and the plumage of birds in tropical climates. In the arctic regions polar bears are white, like vegetables grown out of the influence of light—arctic foxes are white in winter and brown in summer. Fishes inhabiting deep water chiefly are

grey, or brown, or black; those living near the surface are of rich and various colours.

That the measurement of the energy of true light should be by an appeal to its influence on organised matter, and not on inorganic, is a testimony borne by all observations, and even suggested by the records of Creation, the earth having been prepared by the creation of light for animal and vegetable life even before they were formed upon it. This measurement has not yet been made.

(To be continued.)

CORRESPONDENCE.

THE CHEMICAL SOCIETY'S NEW ROOMS.

To the Editor of the Chemical News.

SIR,—Your correspondent "Ventilator" has given expression to the general feeling of dissatisfaction with which the *habitués* of the Chemical Society view its new meeting-room. The room in itself is well enough, but the way in which it is lighted and fitted is a disgrace.

Chemists are credited with a knowledge of the principles of sanitary science, and it seems incomprehensible why these should be so isolated in the room over which chemists have control.

The trooper who, on the march to Coomassie, experiences an attack of sun-stroke will be cared for by a grateful country. But what will the grateful country think of the votary of Science who experiences an attack of gas-stroke at Burlington House, especially when she hears the victim is a chemist, and it has occurred in the chemists' special quarters.

I write more in the interest of Fellows non-resident in London, who are not quite up to the doings of their metropolitan brethren, and strongly advise all such who contemplate visiting their meeting room in Burlington House to bring a flask of cold water, a slaked lime respirator, and an umbrella.—I am, &c.,

SLAKED LIME.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopaedic list of chemical papers published abroad during the past week, with abstracts of all extracts of advertisements and reviews. The two half-yearly volumes of the CHEMICAL NEWS, with their copious indices, will, therefore, be equivalent to an English edition of the "Zahnberichte."

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences. November 10, 1873.

Action of Lead upon Water.—M. Dumas.—The author describes a former experiment in which five bottles containing leaden shot were partially filled with the following waters respectively:—Distilled water, rain-water, Seine water, Ourcq water, and well-water. It was found that the one containing distilled water showed in a very short time traces of lead in solution, whilst the waters charged more or less with calcareous salts contained none. The rapidity with which pure water acts upon lead is surprising, and the effect produced by traces of lime in preventing this reaction is not less so. It is impossible not to be reminded of Schlesinger's observations upon clay, which, in pure water, remains indefinitely suspended, but which is precipitated by the slightest trace of lime salts.

The author thinks that pure water is an agent not yet perfectly known, and that its properties differ from those of common water more than is suspected. In the conversation which followed, M. Elie de Beaumont remarked that Schlessing's observation explained fully the clear and sparkling character of calcareous waters.

Absorption of Ammonia by Saline Solutions.—F. M. Raoult.—Among the saline solutions reputed indecomposable by ammonia, there are some which, as they are saturated with this gas, lose the faculty of holding in solution all the dissolved salt, and deposit it in the form of crystals, which may, or may not, contain ammonia. There are others which, although concentrated, deposit nothing under these circumstances; the experiments of the author refer to the latter. The results show that the solubility of ammonia in solutions of potassa is less than in pure water, in proportion as such solutions are more concentrated. Solutions of soda act exactly like those of potassa of the same strength. Solutions of nitrates of soda and of ammonia absorb just as much ammonia as pure water under the same circumstances. Dry nitrate of soda absorbs not a trace of ammonia, while nitrate of ammonia takes up a considerable quantity. Solutions of nitrate of lime absorb more ammonia than does water, though there is no evidence either of decomposition or of combination. As to the effect of the degree of concentration of solutions upon the quantity of ammonia absorbed, the author proposes the following law:—The difference between the coefficient of the solubility of ammonia in water, and in solutions more or less concentrated of one and the same salt, is proportional to the weight of salt contained in a constant volume of the liquid, measured before the absorption of the gas. This law may meet with exceptions for the extremely concentrated solutions of some bodies, such as the hydrates of potassa and soda, but it holds good for all whose boiling-points do not exceed 110° C.

Presence and Determination of Titanium and Vanadium in the Basalts of the Neighbourhood of Cleimont-Ferrand.—M. V. Roussel.—The author finds the above basalts richer in titanium than any hitherto examined. The samples, in fine powder, were fused with thrice their weight of carbonate of soda; the mass, when cold, was powdered, and treated with water acidulated with hydrochloric acid; it is evaporated to dryness, heated for twenty-four hours on the water-bath, treated anew with acidulated water, and then filtered. The silica eliminated is, after calcination, set to digest for twelve to eighteen hours in hot concentrated sulphuric acid, treated after cooling with an excess of cold water, and filtered. This operation is repeated, and the total liquid is mixed with ammonia, which throws down titanic acid. It is filtered, washed, and ignited. The liquid separated from the silica contains also titanic acid; to separate it, it is treated with sulphate of soda, sulphurous acid, and hyposulphite of soda, boiled for twenty minutes, and there is left the mixed precipitate of sulphur, alumina, and titanic acid. The sulphur is driven off by gentle heating, and the residue is mixed with the former precipitate, and digested in a sealed tube with pure, hot, concentrated hydrochloric acid, in order to eliminate the alumina. After this series of operations, the titanic acid is pure, and may be dried and weighed. The same basalts contain vanadium, but in a far smaller proportion. To obtain a ponderable quantity, it is necessary to operate upon a sample twenty times larger than is required for the detection of titanium. The basalt is melted with carbonate of soda, and the mass oxidised with a little saltpetre. After cooling, the pulverised mass is treated with a large quantity of boiling water, filtered, and washed perfectly. The liquid is evaporated, boiled with carbonate of ammonia, and filtered, treated with hydrosulphate of ammonia, and left to settle for two or three days. If the solution contains vanadium, at this moment the fine red colour of sulphide of vanadium when dissolved in an alkaline sul-

phide appears in the liquid. It is filtered, and hydrochloric acid is poured into the liquid, which throws down sulphide of vanadium mixed with sulphur. The latter disappears on careful heating, when the sulphide of vanadium, VS_2 , is weighed. The largest percentage of titanium was 2.378, and that of vanadium 0.023.

Determination of Sugar by means of Iron.—E. Riffard.—This method has been already noticed in the CHEMICAL NEWS.

Examination of Law Proposed by M. Helmholtz to Represent the Action of Two Elements of a Current.—M. Bertrand.

Action of Water on Lead Pipes.—M. Belgrand.—This note goes to prove the innocuity of lead pipes in the Paris water service. Of the public pipes, there are only 3000 m. of lead out of a total of some 1,400,000 m. The branch pipes for domestic use have a total length of 1,550,000 m., but in this network each litre of water traverses only from 5 m. to 100 m. of lead, and, where the house is inhabited, the water is but a short time in contact with the lead—nine hours at the most (in the night). In the 3 kilometres of public pipes, the interior surface is quite smooth, and without trace of erosion, even in pipes 200 years old. The branch pipes have a thin adherent crust (lime, &c.), which hinders the contact of water and lead. M. Belgrand further made a series of analyses of water used in dwelling-houses, and found no traces of lead. His collaborator, M. Le Blanc, experimented on a longer contact of water with lead; and his tables show that very pure water, such as that from the wells of Grenelle, though possessing much less saline matter than the Seine water, has yet the property of preserving lead from oxidation during long contact. Rain-water, even, does not attack the lead, unless it has been received after a sort of prolonged washing of the atmosphere by rains. When it is become insensible to the action of reagents of lime, it begins to attack the lead rapidly, like distilled water. Salts of lime, in the most minute quantity, notably prevent the oxidation of lead in contact with water. The general conclusion M. Belgrand arrives at is that the danger in Paris is *nil*, and that it is not desirable to substitute other pipes for the lead.

Historic Point Relative to Animal Heat.—M. Berthelot.—The point is, that M. de Lagrange was right in supposing, in opposition to Lavoisier, that animal heat was not wholly produced in the lungs, but wrong in his grounds for this view, which were that the organ would in that case have been in danger of destruction.

Establishment of a Meteorological Observatory at the Foot of the Pic du Midi by the Ramond Society.—M. Deville.

Note on Magnetism.—M. Gauguain.—The author, starting from an observation by M. Haecker, experimented on the changes in a horse-shoe electro-magnet when its armature is detached. A current was passed, the armature applied, then detached, then the current broken, and the armature applied and removed several times successively. The decrease of magnetism was measured by the author's method of induction currents, and these currents of demagnetisation were, for the first, second, third, fourth, and twentieth separation successively, 176° , 195° , 160° , 145° , and 134° . When the armature has been applied and detached twenty times, the magnetism is not varied, though the process be repeated ever so often; and if the magnet be then put aside, with or without its armature, it will be found after some months in the same state as when left. Thus, in speaking of the magnetism acquired by iron in different conditions, it is necessary to mention the number of separations of the armature after the source of magnetisation has been suppressed. There are circumstances (M. Gauguain proceeds to point out) in which the separation of the armature seems to increase the magnetisation. Having brought an electro-magnet to the above constant state (Haecker), he determined the current

of detachment (*d'arrachement*) developed by this constant magnetism. The series of operations indicated having been repeated fifty times, he found the value of the current at the end of each series increase as the operations were multiplied, at least to a certain limit. It rises to the extent of a fifth of the value obtained at the end of the first series. This increase does not depend on the time during which the reducing current circulates; it is the same when this passes for an hour and for only a few seconds. The increase does not occur when one interrupts and renews the inducing current a number of times without detaching the armature. The armature must be detached after each of the interruptions of the inducing current. It might thus appear that the detachment of the armature increases the magnetisation, but this the author does not consider a true interpretation of the facts.

Aqueous Exhalation of Plants in Air and in Carbonic Acid.—M. Barthelemy.—The author experimented by an improved form of Mariotte's method, placing a branch in a closed receiver, and measuring the water condensed. He considers the aqueous exhalation may occur in three ways:—(1) By insensible exhalation over the whole cuticular surface, through a veritable gaseous dialysis; (2) by a sudden emission of saturated gases, which escape by the stomata when the plant is subjected to a rapid elevation of temperature (especially in a receiver); (3) by accidental exudation, arising from deficient equilibrium between the absorbent action of the roots and the work of the aerial parts, and fixation of carbon added to the elements of water, a work which ceases with the light. He further concludes that heat exercises a great influence on this function, and that, with equal temperature, carbonic acid in presence of light, has the effect of diminishing the evaporation.

New Researches on the Upward Passage of Nutrients Matters in Bark.—M. Faivre.—(Extra.)—The experiments consisted in making annulations, partial or complete, on the stems and branches of mulberries, walnuts, and cherry-laurels; also valves or tubes of bark separated from the wood and bearing buds; and in combining complete annulations with partial, or with valves or cortical tubes. Direct evidence was obtained of the ascent by the bark.

Influence of Drinking-Water in the Propagation of Cholera.—M. Colin.

Several Cases of Intermittence of the Voltaic Current.—M. Cazin.—The first experiment was briefly this:—A coil, connected with a battery, passed round an iron tube; the circuit could be opened or closed by a platinum point, which dipped in mercury. If, the platinum and mercury being first separate, they were put in communication with the armature of a condenser, or if a layer of alcohol was interposed between the mercury and the platinum point, a continuous sound was heard in the iron core (it ceased if the alcohol was suppressed or the point dipped in the mercury); this indicates that the current passed through the glass in the former case, through the alcohol in the latter, and that its passage was intermittent. The iron core undergoes a rapid series of magnetisations and demagnetisations. The author thinks the cause of the intermittence is the condensing action of glass and of alcohol. When the two faces of the insulating substance have acquired a certain electric potential, a discharge takes place through the insulating layer. The magnetism of the core grows during the charge of the condenser, and diminishes during its discharge. The sound is produced during the diminution of magnetism. The second experiment refers to the spark of rupture, which, produced in alcohol in the above arrangement, is observed to be compound, and the sound it gives presents a similar mode of division. The production of a sound in the condenser also proves that there is a partial discharge through the insulating matter, although this appears nowhere to be perforated. In a third experiment, the platinum point could be moved up and down in its support by screwing,

Dipping in the mercury, it is gradually raised till the spark passes through the alcohol; then a succession of sparks occur, and continues some time. The surface of mercury evidently oscillates under the point. One possible cause of this is that, the spark being formed by mercury vapour, the elastic force of this vapour depresses the surface of liquid. The latter returns to its original level, passes it in virtue of acquired velocity, and rejoins the platinum point; falling back, it produces a new interruption, and so on. But this cannot be the only cause, for the circumstances favourable to this automatic interruption are those which accompany the decomposition of the spark of rupture into a small number of bright successive lines. By changing the extent of the condenser, one may change the number of divisions in the spark; if the condenser be suppressed, there will merely be a crepitating voltaic arc. Probably the period of oscillation of the mercury and the intermittence of discharge of the condenser are in mutual dependence. The crepitations of the ordinary voltaic arc are, the author thinks, a phenomenon belonging to the class above indicated. All the facts permit of being united by the following proposition:—The interposition of a suitable resistance in the voltaic circuit causes intermittence of current. Further, the important conclusion is warranted that the current is a succession of modifications which are accomplished periodically in the circuit.

Process of Determining the Nodes in a Sounding-Pipe.—M. Bourbouze.—The author substitutes, for M. König's capsules, a simple membrane of flexible caoutchouc, to which he attaches a light silvered mirror, which oscillates with it. A ray of light is reflected from the mirror, and figures like those of M. Lissajous are obtained. The image has its maximum of elongation when the mirror is at a node.

Action of Aërated Water on Lead, considered with reference to Hygiene and Legal Medicine.—M. Fardos.—The author's remarks are partly directed against the employment of lead in rinsing bottles.

Influence exercised by the Moon on Meteorological Phenomena.—M. Marchaud.—From examining the distribution of storms in the country between Paris and La Manche, from 1785 to 1872, M. Marchaud finds an appreciable relation to the age of the moon. Thus the probabilities of appearance of storm phenomena are great the tenth, fourteenth, and fifteenth days of the moon—especially the tenth; they are appreciable upon the eighteenth; well marked at the twenty-first; decrease from the twenty-second, and again become very important in the three days which precede or which follow the neomenia. On the other hand, the probabilities descend to their minimum on the twentieth and twenty-fourth day, but above all the sixth. The author also shows, by tables, &c., that the moon has an appreciable influence on thermometric and barometric changes, on the state of the sky, and the distribution of rains.

Processes for Determining the Direction and Force of the Wind, Suppression of Vanes, Application to Cyclones.—M. Tany.—Vanes have three faults:—(1). They indicate a direction when there is no wind. (2). They do not indicate the force or velocity of wind. (3). They only show the horizontal component, not the real direction. The author substitutes a light resistant bandrol, or little flag, suspended by a cord from a metallic ring, pulleyed on a vertical rod.

Bulletin de la Société Chimique de Paris, tome xx., Nos. 8 and 9, November 5, 1873.

Assay of Plumbiferous Mammals.—J. Loewe.—In treating lead ores with nitric acid, a loss generally results from the formation of insoluble sulphate of lead. The solubility of this salt in hyposulphite of soda renders it possible to avoid this inconvenience. After treatment with nitric acid the residue is exhausted with boiling

water, until the soluble salts and the acid are completely eliminated. It is then digested in the cold with a concentrated solution of hyposulphite. After this treatment has been twice or thrice repeated, the residue is exhausted again with water; the lead is then precipitated from the filtrate by sulphuretted hydrogen or sulphide of ammonium; to facilitate the agglomeration of the precipitate and its washing, it is heated in the water-bath. The sulphide is then converted into sulphate, and its weight added to that of the sulphate obtained directly.

Separation of Uranic Oxide and Phosphoric Acid.—E. Reichardt.—This separation can be effected by dissolving the phosphate of uranium in carbonate of soda, and precipitating with a salt of magnesia. If the precipitate of phosphate of uranium is old, it is necessary to dissolve it first in hot concentrated hydrochloric acid, adding nitric acid to peroxidise any iron present. The solution is then heated, and soda added in excess. After a new filtration the phosphoric acid is thrown down by adding ammonia and chloride of magnesia. After twenty-four hours, the liquid is separated from the ammoniacal-phosphate of magnesia. It is acidified with hydrochloric acid, heated, and the oxide of uranium precipitated by ammonia, avoiding excess.

Separation of Molybdic Acid from Phosphoric Acid.—E. Reichardt.—This separation is effected in a manner analogous to the former. The phospho-molybdic compound is dissolved in carbonate of soda, and heated to boiling. After having precipitated the phosphoric acid by means of magnesia-mixture, the solution is treated with aqua-regia, and evaporated to dryness to expel excess of acid. The residue is then treated with water, which leaves the molybdic acid undissolved.

On Certain Derivatives of Cyanoxy-carbonic Ether.—A. Weddige.—Alcoholic ammonia acts upon cyanoxy-carbonic ether, yielding a well-crystallised body, which the author had regarded as the corresponding amid. A new examination convinced him that in this case cyanide of ammonium and urethan were formed. Aniline acts in an analogous manner, and yields hydrocyanic acid and carbonylilic ether. Methylamin appears to act in a similar manner. Hydrochloric acid decomposes cyanoxy-carbonic ether, slowly in the cold, producing oxalic acid and an ammoniacal salt. If sulphuretted hydrogen is passed into the alcoholic solution of this ether, yellow crystals are separated, which crystallise from common ether in fine lemon-coloured prisms, and from boiling water in fine yellow needles. This compound fuses at 63° to 64°. Sodium yields, with cyanoxy-carbonic ether, brown, viscid products. If left in contact with an equivalent of bromine, moisture being excluded, this ether yields, after the lapse of two days, long needles, which are obtained in greater quantity if the mixture is heated in a sealed tube to 100° to 110°. After crystallisation from boiling alcohol, this body forms small, white, hard prisms, fusible at 164° to 165°, and very sparingly soluble in water and ether. They form a polymer of cyanoxy-carbonic ether. Boiling alkalis decompose these crystals, yielding ammonia and oxalic acid.

On α -Cresyl-disulphurous Acid, and on some of its Derivatives.—P. Håkansson.—By the action of fuming sulphuric acid upon cresyl-sulphurous acid, the author has obtained two cresyl-disulphurous acids, α and β . He considers the acid α isomeric with the cresyl-disulphurous acid obtained by Senhofer. The author has examined its potassium, sodium, ammonium, barium, calcium, magnesium, aluminium, manganese, cobalt, cadmium, nickel, zinc, lead, copper, and silver salts, its chloride and amid, the disulphhydrate of tolylen, and disulphobenzoic acid, with some of its salts.

Modification of Nutrition after Loss of Blood.—M. Bauer.—A physiological paper.

Chemical Study on Fever.—M. Manassein.—The author shows that during fever the digestive power of the

gastric juice is very slight, but increases on the addition of an acid.

Case of Poisoning by Arseniuretted Hydrogen.—M. Troost.—Arseniferous zinc, used in separating silver from lead at Stolberg, proved fatal to three of the workmen. Arsenic was detected in the viscera and the fluids of the bodies.

Detection of Metals in the Organism.—MM. Mayençon and Bergeret.—The tissue is treated with aqua regia, and a galvanic couple, consisting of an iron and a platinum wire, is plunged in the liquid. After thirty minutes, the couple is withdrawn, washed in distilled water, dried, immersed in chlorine gas, shaken in the air to get rid of the chlorine, and the platinum is finally rubbed with paper soaked in a solution containing $\frac{1}{1000}$ of iodide of potassium. Mercury produced a red, and lead a yellow, colouration, &c.

PATENTS.

ABRIDGMENTS OF PROVISIONAL AND COMPLETE SPECIFICATIONS.

Improvements in the manufacture of glass mirrors, and in apparatus for grinding and polishing plate glass, also in engraving on glass.—Thomas Brown, 46, Newgate Street, London. (A communication from Edouard Dodé, Paris.) March 5, 1873.—No. 802. This Provisional Specification describes apparatus for grinding and polishing plate glass, also coating rough glass with a platinum enamel, and subsequently platinising such enamel; also engraving or ornamenting glass by the use of boracic acid applied to the surface of the glass in any desired pattern, the glass being afterwards submitted to sufficient heat to fuse the acid.

Improvements in the treatment of blood for the manufacture of manure.—Leonard Oscar Darwath, and Henry Prosper Lisagarray, both of No. 20, Rue des Petits Hôtels, Paris. March 6, 1873.—No. 809. This invention consists in treating blood with hydrochloric, nitric, sulphuric, sulphurous, or other mineral acids, or with sulphites, especially sulphite of soda.

Improvements in drying and roasting malt, grain, and other substances.—George Phillips, 71, Tunnell Park Road, Islington, Middlesex. March 6, 1873.—No. 821. This Provisional Specification describes special means of applying hot air under pressure for drying and roasting malt, grain, and other substances.

Improvements in apparatus employed in the concentration of sulphuric acid.—Henry Bernoulli Barlow, patent agent, Manchester, Lancashire. (A communication from Nicola, Jos. Galland, engineer, Paris.) March 7, 1873.—No. 827. This invention consists first in the mode of constructing the vessels in which the sulphuric acid is concentrated, and secondly to the general arrangement of the condensing vessels, the apparatus being so added to facilitate the application of heat to the vessels and the pipes for connecting them together, and to the cisterns in which the vapours are condensed and the acid is collected, and the pump for forming a partial vacuum. The concentrating vessels are made of cast-iron, lined with lead or other suitable soft metal.

Improvements in the manufacture of sulphates of soda and of potassa, and in the production of chlorine.—James Hargreaves, chemist, and Thomas Robinson, iron founder, both of Widnes, Lancashire. March 7, 1873.—No. 828. The patentees avail themselves of the same reactions which occur in roasting cupreous pyrites with common salt preparatory to separating copper by the well known wet process, but they keep their chlorides free from contact with large masses of oxide of iron. Copper, or a salt thereof, is added to a solution of sodium or potassium, and the mixed mass exposed to the action of sulphurous acid gas and atmospheric air. The chloride is converted into sulphate, and chlorine set free. The chlorides may be moulded or broken into suitable pieces. Manganese or chromium may be used instead of copper. The means and apparatus preferred are described in previous patents, Nos. 3445, 3047 (1870); 1723, 1851, 1920 (1871); and 3052 (1872).

A new or improved amalgam for the better imitation of silver.—John Keene, Scott's Yard, Bosh Lane, Cannon Street, London. (A communication from Madame Pirch Bauduin, Rue des Marais, Paris.) March 8, 1873.—No. 834. The novelty in this case consists in the peculiar action of metals and of a relative quantity of the same in the introduction of cobalt, to form an amalgam resembling silver.

Improvements in utilising refuse matter for the manufacture of fuel and manure.—James Wadsworth, machinist, Manchester. March 8, 1873. No. 841. The features of novelty in this invention consist in taking street sweepings, ashes and cinders, coke from gas works, mud from sewage and foul river settling beds; and, when necessary, adding a portion of clay to give a proper consistency. I then mould the same into suitable shapes for burning as fuel, or I calcine in kilns or suitable furnaces. Or I sometimes take the street sweepings alone, or wash the mud heretofore mentioned, and mix with a portion of clay and treat in like manner. The residuum when burned as a fuel I crush to powder, and use as a decoloriser as described.

New utilisation of the acid residues resulting from the manufacture of chlorine.—Frédéric Kuhlmann, Professor of Chemistry, Paris. March 8, 1873.—No. 847. The invention consists—(1) in the application of the residues of the manufacture of chlorine for the preparation

of linealide of manganese, the protoxide of manganese being superoxidized by means of oxidized air or preferably with nitric acid or nitrous gases. (2) In the application of the oxide of manganese precipitate, obtained by the action of lime on the residues of the manufacture of chlorine in metallurgy.

Improvements in the working of coal-gas tar. John Rowley, chemist, 54, Camberwell Road, Surrey. March 20, 1873.—No. 868. I take the coal-gas tar and its homologous products, either together or separate, and treat them with acids, alkalis, and chlorine. I then distill and obtain benzol, anthracene, and other products suitable for making aniline dyes.

Improvements relating to the manufacture of chlorine by means of compounds of manganese regenerated in the wet way. Walter Weldon, 29, The Cedars, Putney, Surrey. March 11, 1873.—No. 868. This invention relates to the process which is the subject of my former patent, dated respectively the 26th July, 1866; the 15th January, 1867; the 4th September, 1867; the 24th February, 1868; the 24th February, 1868, and the 10th March, 1869. It consists in economising manganese by subjecting the deposit which forms in the chloride of manganese to a certain mechanical washing, in economic acid and limestone by employing in the stills an excess of manganese mud, neutralising, if necessary, the last portions of the acid by lime, allowing the unoxidised peroxide of manganese to settle out, and then, when it has accumulated sufficiently, employing the deposit so obtained instead of fresh manganese mud, and dissolving it completely by an excess of acid, and in certain arrangements of apparatus for effecting these objects.

NOTES AND QUERIES.

Fluorescent Spectrum.—Will some one kindly tell me what is meant by this?—Wm. JOHN GREY.

Extraction of Lead from Sulphate.—Can any of your correspondents kindly inform me of a process for extracting lead from the sulphate arising in the manufacture of sulphuric acid?—C. H. N.

Glacial Acetic Acid and Acetone.—Will any of the readers of the CHEMICAL NEWS give the inquiry any information as to how the above articles are made?—W. W.

Fuller's Earth.—I understand Fuller's earth, in a powdered state, is extensively employed on the Continent for refining rosin oil. Can any of your readers inform me of the process, and where ground Fuller's earth may be had?—A. K. C.

Notes on the Utilisation of Sewage.—(From the "Report of the Main Drainage Committee for 1864," vol. 429.)

221. (To Mr. Whitehead.) Does the lime process succeed in purifying the sewage?—Very far from it, and I take it that one cause is this: that the lime is not used in the most effective manner. I think it is the same as the smoke-consuming furnace; it depends upon the discretion of the man who puts on the coal whether it is effective or not.

222. (To the same.) Have you ever known lime to succeed in purifying the water?—I have known lime to succeed, but this evil attaches to it, that it kills the fish.

223. And does it not also render the water unwholesome for drinking?—Quite so.

224. Would it be unprofitable as a commercial speculation?—Certainly.

225. You think that it would not be good for agricultural purposes?—No, as far as stock was concerned.

226. Then would you say that the lime process was a failure?—I say that the lime process as it has been carried out in this instance was a great failure, but I think that it admits of great improvements. 227. Previous to this lime process being used, the cattle drank the water of the stream, and now they cannot drink it and the fish die in the stream; is that so?—That is so.

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THE CHEMICAL NEWS.

VOL. XXVIII. No. 735.

ON ATOMS.

(Continued from p. 282).

I AM very glad that the two letters in last CHEMICAL NEWS are sufficiently calm to allow me, without feeling annoyed, to reply. I never expect very tolerant language from scientific men. I am, however, quite pleased with the words alluded to, in the sense that they seem the result of a desire to deal fairly in the matter, and to listen as well as to think. I cannot at present discuss, as I said, but I must make my meaning plainer, and do what honour my words can do to two men. The first of these is Leucippus (some people prefer Leucippos, for reasons of a limited range in the English language). I prefer to call the atomic theory of the ancients that of Leucippus, from the simple fact that he first propounded it. Many men took it up afterwards, and Lucretius went carefully into detail, but the first that published it deservedly takes the name, and I think this is too much forgotten. In modern times we have Newton, with exactly the same theory, but it would be unfair to connect him with it, because he really added nothing essential.

Dalton held the same theory of fundamental atoms or ultimate particles, as Dr. Wright has observed, and as I said in last letter; but he made an addition so decided that he marks the most important era in the history of atoms. Lucretius tells us that the primordial atoms are very different in their forms, so different that some are hooked. This shows an imperfect conception of the subject, because he did not see that smooth atoms could make all forms and qualities of bodies. Dalton had no more to add him upon physical grounds, and he explained his idea of atom or ultimate particle from the chemical action of bodies. He had the idea of mechanical fitting. This suited the thousands of chemical phenomena so well that it has altered the whole *cosmos* to our eyes, and our theories of the constitution of compounds have had reason in them since Dalton's time. He says that a certain volume enters into combination, and it has a certain weight. That is proved to be true, and it is his, without theory. In addition, he says that the certain weight is the ultimate particle, because you find it however low you go. That may be said to be theoretical, but it is full of good analogy and sound sense. Somelike to use "equivalent," but that word does not mean anything by itself, and can stand only in relation to something else. If, for example, we have oxygen and calcium alone, neither can be called an equivalent. One may say, equivalent to what? But if sodium takes the place of calcium, then it may receive the name *pro tempore*. But what is the bulk of an atom? Dalton said, substantially, I do not know; but when you have found the smallest possible piece of calcium oxide, then it may be divided into an ultimate particle of calcium and one of oxygen. His meaning is clear enough, and the use of atom in the sense used hitherto by chemists is rationally founded, whilst the use of equivalent assumes virtually the same facts, but hesitates to give them their full bearing, according to my mind. Dalton having decided, proceeded to give the relative weight of each of his ultimate particles, and arranged the subject, putting aside many fancies of Lucretius, and back to Anaximander, with a few words.

Supposing Dalton to be correct in his very common-sense view, I think we ought to call the atom, when it has attained this precise state of definition, the Daltonian atom, because we really ought never to lose an opportunity of honouring those men who have been so divinely

gifted as by a thought to have illuminated all the times to come. It is as if they had a part of the power which said "Let there be light, and there was light." This of course is not used as argument,—nor indeed am I arguing at all but thinking that I am making matters clear.

Now although Dalton could say, proudly, "Show me, even in idea, a particle so small that it shall not conform to my rule," there is a certain faculty that leads us on to ask—What would happen if Dalton's atoms were split? We have no chemical experiment leading us to believe that this ever occurs amongst us, but I wish to say that a man may be a believer in Daltonian atoms, and yet believe that there are no final atoms; or he may believe in no matter existing at all. I fear I am repeating myself, but it may do no harm to let this be said in a fresh series of words. I dare say Dalton, as a far-seeing man, would have speculated as readily as any man on the divisibility of the elements, or "articles" as he sometimes called them, but he did not pretend to have gone farther.

Whilst the division of the Daltonian atom is one mode of, theoretically at least, obtaining new elements, there are other methods, and not the least beautiful; perhaps the most beautiful of all is that of the late Prof. Graham's. He gave it as a possibility that, there being one matter,—and we must suppose that to be atomic,—the differences of elementary bodies may be caused by the different rates of speed at which the atoms move; in other words, that atoms do not differ in shape, size, &c., but in primordial activity. This was the result of his examination of gases. It is a beautiful theory. We are of course obliged to give these atoms a primordial power, and this moderns agree to do along with the ancients. Even here, however, we must suppose a certain force capable of overcoming that primordial force, and, if so, the speed would be destroyed and a new element would come to our view. Who knows? perhaps it would be too active, and seek combination before we caught it; but with what would it combine? These are questions only, but they show another mode of supposing a chemistry beneath our chemistry; and our wandering exacting intellects demand that even that primordial atom, before deciding on its velocity, shall be divided, that we may see what it contains.

Another interesting view was put out by Sir William Thomson, indicating a variety of motions—not mere speed—in a primordial fluid or substance. In this case the practical Daltonian stage of matter would be a very complex body. Not having the paper before me I shall not attempt to say more; but the motion in these atoms, also, we may suppose overcomable by a superior motion, although he seemed not to think so.

In both of these latter cases, some adjustment would be requisite to fit into Dalton's weight, but still, even in them, it is needful to imagine a certain amount of matter gathered together to act. The reason of this is that we cannot picture to ourselves clearly what would be the condition of the matter before it was so gathered together. And, indeed, we become able to talk sensibly only when we begin from the atom upwards; below it is speculation. For this reason, a chemist may be a most confirmed atomist, and hold any theory of the constitution of matter. As to infinite divisibility, some have thought of it all their lives, and read much, but are glad to rest in the belief that they cannot understand why it should be true, or why it should not be true. None of the above oppose Dalton, only cause a change, which, with permission, may form the subject of a third letter. When we come to the physical theories of the present time, we find men proceeding with certainty, or almost certainty, in the belief that gases are composed of atoms. Now Dr. Wright would say that this is scarcely correct, because "molecule" is the word used. I know it, but I have given my own interpretation of the word atom, or, rather, that of chemists taking Dalton's view. I call one "the smallest undivided particle;" that of the older and of many later physicists is "the smallest indivisible particle." In considering the constitution of gases, our

physicists speak of the movement of undivided particles, that is, particles which they have no good reason to consider as existing divided in the gas. The molecular mobility of gases, or of elementary particles of gases, is not put a stop to by combination with another gas, as oxygen with nitrogen, and if we call one an atom, and the other a molecule, we should probably speak more according to our knowledge. Atom, used as an undivided molecule, suits chemists well, because they can say, as now, an atom of a complicate substance, say albumen, knowing that in that case, although physically divisible into several elements, the removal of any one destroys the identity of that which can exist only as a group.

I have not opposed Dr. Wright by speaking against his view, but I may say that I see no weakening of the Daltonian atom in any theory of motion among the particles; Dalton's theory is wide enough to hold it all. When bodies are isomeric, we naturally look either to a difference in the arrangement of the particles, or a motion amongst them. Dalton's theory is well enough prepared for the first; I do not know that he thought of the second, but, had he done so, he would not have required to change either weight, number, or size of any of the component parts.

I shall only add that the quotation from Watts's magnificent and valuable "Dictionary" does not please me; and, first, the words "some use it in its strict Daltonian materialistic sense." In what other sense can we use it except a materialistic? Even Boscovich would use it in its materialistic sense. The immaterial, if it is desired, would certainly be something below the atom in any use of the word known to me. Again, "Others use it in an abstract sense, only to express the smallest indivisible combining proportion of a body." Why, that is Dalton's meaning (leaving out the word abstract, which is not in harmony with the other clause), so that he includes both. Then it is added, "and consider the proportional number of a body as an ultimate or unexplained property belonging to it." I feel sure that Dalton considered it both ultimate and unexplained. I do not understand *greatest common divisor system*, except in a sense which brings us also to Dalton's atom; his system is, in fact, so wide that I do not see any facts that shut it out, but I have tried to see, and, in doing so, the subject beyond has become a mystery. If, however, Dr. Wright really thinks that the use of the word atom confuses the student's mind, that certainly is a good reason for not using it, and better for a teacher than any facts which came from the beautiful researches of Joule, of Clausius, of Clerk-Maxwell, Sir William Thomson, and Graham. I think it better, however, before changing, for chemists to see what these researches will produce; to me they are developments of Dalton: but the subject in abstract is very difficult, and it will be long before we all think alike, so I give only a few scraps of the thoughts of one who can see but a little way at best, being only an

ATOM.

ON THE SENSITIVENESS OF BROMIDE OF SILVER TO THE SO-CALLED CHEMICALLY INACTIVE COLOURS.

By Prof. HERMANN VOGEL.

It is known that certain colours—such as red, yellow, and green—act very slightly, or not at all, upon a photographic film. This circumstance not only puts a difficulty in the way of the photographer of colours (oil paintings, &c.) but is also a stumbling block to the portrait photographer, who has to depict not only coloured drapery, but yellowish complexions, blonde hair, and red cheeks. High lights which are tinged with yellow appear dark in photography, and shadows when tinged with blue are reproduced lighter

than they should be, the only way of subsequently mending matters being by means of retouching upon the negative.

This abnormal sensitiveness for colours possessed by photographic plates is more conspicuous when the lines of the spectrum are rendered by photography, when beyond the violet a vigorous action is apparent, while in the visual spectrum—according to Schultz-Sellack—the action is not perceived farther than line E in green. Recent experiments with bromide of silver have, however, shown me that the sensitiveness of the body not only reaches much further, but that if certain accelerating substances (or "preservatives," as they are sometimes called) are employed the action goes as far as red—that is to say, reaches a point where hitherto it has been to photography as the darkest night.

I recently received from England some Wortley dry collodio-bromide plates. These I exposed to the spectrum, and found to my astonishment that they were more sensitive at the line E in green than in light blue at the line F. Here, therefore, I obtained a result in regard to sensitiveness in opposition to experiences hitherto recorded, the film being more sensitive for colour supposed to have little chemical activity than for a vigorous chemical tint. It is true not all the Wortley plates gave this result, some of them giving it but faintly, and others not at all. At first I believed the same to be due to alkaline development, and said as much, but found afterwards that an iron developer gave similar results. This circumstance caused me to undertake a closer investigation of the sensitiveness of bromide of silver in connection with the spectrum colours.

My apparatus I prepared with the aid of a photographic camera fitted with a Steinheil lens, and this was directed against the prism of a spectroscop. The slit was 0.25 millimetres wide. The sun's rays were thrown upon this with the aid of a Foucault heliostat, which my friend Dr. Zenker placed at my disposal; the spectrum image from D to G measured 35 millimetres. For comparative experiment I chose the time from 11 a.m. to 5 p.m., with a sky perfectly free from cloud—a thing rather difficult to obtain at this time of the year. The period of exposure lasted, as a rule, about ten minutes. After exposure, the plates were developed by means of sulphate of iron. At the very first experiment I found that the sensitiveness of the bromide of silver stretched to a point much further than Dr. Schultz-Sellack has shown. This gentleman only obtained an action of the ultra-violet near line F in blue. In my experiments the sensitiveness in every case was shown to extend beyond line F, more or less far according to the transparency of the atmosphere.

I employed the bromide of silver in two forms: that is to say, in a moist state, with nitrate of silver solution attached to it, and, again, as dry plates, produced by washing off the silver solution and drying. They acted differently. It was found that dry bromide of silver has a much greater sensitiveness for colours than bromide of silver moistened with silver solution. The latter, on development with an acid developer, showed sensitiveness to midway between D and E—near to the yellow, therefore; while the dry film gave a sensitiveness for 2 millimetres beyond, into the orange.

The nature of the impression on the two plates was also different. In the wet bromide of silver an exceedingly vigorous action was observed between G and F (in indigo and blue). At F, however, it vanished rapidly, and only a slight action was perceptible beyond E. The dry plate showed a much weaker action in the blue than the other, but the impression went off more gradually, and reached, as already stated, as far as D.

Dry bromide of silver is therefore more sensitive for the less refrangible, and wet bromide of silver for the highly refrangible, blue rays of the visible spectrum.

For ordinary photographic plates, a solution of silver is a vigorous accelerator—that is to say, it increases the sensitiveness, because it combines with the iodine or

bromine set free on exposure. When this action takes place principally in blue, it may be explained that the blue rays are more vigorously absorbed by the wet film than the others. I was aware, last summer, when experimenting with iodide of silver, that a body only then enhances the sensitiveness when it is not only capable of combining chemically with free iodine, but absorbs also the chemically active rays. For instance, dry pyrogallie acid, which combines with iodine, makes an excellent sensitiser, but in solution is of no avail, as it allows the chemical rays to go through unimpeded. Optical and chemical action must be combined in a body in order to be an accelerator.

As already remarked, the sensitiveness of the dry bromide plate gradually diminishes from blue to red. Of the phenomenon which I observed in so marked a degree upon most of the English bromide of silver plates—viz., a lack of sensitiveness from violet to blue, and an increase from blue to green—I observed nothing when working with bromide of silver plates prepared by myself. The explanation just referred to, of the action of nitrate of silver solution upon bromide of silver, caused me to think that the English bromide of silver plates contained a body of some kind which absorbed the green in a higher degree than the blue. So far as is known a yellowish pigment is sometimes added for the accredited purpose of checking the chemical blue rays, but it is possible that the body here employed does not absorb the blue rays, but allow them to pass, only hindering them in some degree.

The Wortley plates contain nitrate of uranium, gum, gallic acid, besides the yellow colouring matter. To ascertain whether this coating exerts any action, I washed one of the plates with alcohol and water, and obtained in that way a plate which did not show any increased sensitiveness in the green. I next essayed to impregnate bromide of silver with a substance especially capable of absorbing the yellow rays, and which combines with free bromine and iodine, in the hope by this means of improving the sensitiveness of the plate for yellow rays. I chose coralline for the purpose which Professor Liebermann kindly placed at my disposal. A very dilute solution examined under the spectroscope gives an absorption-band between D and E, and stronger solutions cause the band to be increased beyond D; on the other hand, blue near F is allowed to pass to an appreciable extent.

I dissolved the coralline in alcohol, and added to it some of my bromised collodion, so that it became coloured of a vigorous red. With this collodion some bromide of silver dry plates were prepared, which were tinted of a reddish colour, and these, submitted to the action of the spectrum, confirmed my previous speculations; the plates showed themselves to be sensitive in the indigo portion of the spectrum, and the sensitiveness diminished towards light blue, became weak at F, then increased, and appeared in yellow as vigorous almost as in indigo. I had therefore discovered a method of producing bromide of silver plates which could be acted upon quite as vigorously by a colour held to be bereft of active chemical action—as, for instance, yellow—as by a colour such as indigo, which hitherto had been considered to exert the greatest chemical action.

After these experiments, I was led to hope that any other body capable of combining with bromine, and which would absorb red vigorously, would also heighten the sensitiveness of bromide of silver for the red rays. Such a substance I found among the green aniline colours. These absorbed vigorously the red rays midway between D and C; the absorption D, stretched with greater concentration farther towards D—yellow, green, and blue, passing through almost intact. A collodion tinted with this aniline green was found, indeed, to be sensitive into the red. The sensitiveness diminished from indigo to yellow, and then increased, and, on that spot where the absorption-band had been remarked, there the film was most sensitive to red.

From these experiments we may conclude, I think, with

tolerable accuracy, that it is possible to render bromide of silver sensitive to any desired colour, improving its sensitiveness for certain colours. It is only necessary to add to the bromide of silver a suitable body which absorbs one chosen colour, but not the others. Perhaps we shall get so far as to photograph the ultra-red spectrum, just as we have depicted in the camera the ultra-violet. The till-now supposed photographic inactivity of certain colours, which is so often a stumbling-block, would then be obviated. In how far the results are of practical importance the following experiment will show:—A blue band upon a yellow ground was photographed. With an ordinary iodide of silver collodion plate, I obtained a white band upon a black ground. With a bromide of silver coralline plate, upon which blue and yellow acted with equal power, nothing could be obtained, I foresaw, and for this reason, I put in front of the lens a yellow glass plate, which absorbed the blue light, and allowed the yellow rays to pass through unheeded; and then I was enabled to obtain, after a sufficiently long exposure, a dark band upon a light ground.

The matter is, however, not simply a technical one, but also of interest from a scientific point of view. Until now we believed that the haloid salts of silver could only be chemically altered by rays which they absorb in to a notable degree, and the value of "accelerators" or "preservatives" was scarcely credited (Schultz-Sellac).

My experiments teach that in the sensitiveness of photographic plates it is not only the optical absorption power of the sensitive silver salts, but also the optical absorption power of substances mixed with them, that exercises an important influence in the matter.—*The Photographic News.*

ON THE ENERGIES OF THE IMPONDERABLES, WITH ESPECIAL REFERENCE TO THE MEASUREMENT AND UTILISATION OF THEM.*

By the Rev. ARTHUR RIGG, M.A.

(Continued from page 312).

LECTURE VII.

On the Energy of Heat, with especial reference to the Measurement and Utilisation of it.

THE energy of heat has, in one form or other, attracted more notice than that of any of the other imponderables with which this course of Cantor Lectures has to deal. Various explanations of the cause of heat being possessed of energy have been given, but it was not until the closing years of the last century that views on this question were first enunciated, which have since borne such good fruit. Count Rumford, in 1798, by an experiment in the boring of cannon in the arsenal at Munich, and Sir Humphrey Davy, in 1799, by the liquefaction of two pieces of ice by the friction of each on the other, laid the foundation of that explanation which has been so successfully generalised, and which even now is hopefully pursued.

The first question that presents itself to us is, "What is heat?" And in order to present the modes suggested for measuring it which are diagrammatically expressed on the wall, it will be needful to make some preliminary statements. In the general table of energies the sources of heat are represented as the sun and fuel. That term fuel might with very good reason have been omitted, for the one source of heat is the sun; fuel is a secondary source, having its primary in the sun. Heat obtained from the sun and the circumstances under which it is obtained are foreign to the subject of this lecture. Heat obtained from fuel, and also from the sun, is kinetic, or capable of producing motion when it is radiant, or passing from place to place; and it is potential, or stored up,

* The Cantor Lectures, delivered before the Society of Arts.

when it is absorbed. Now it was absorbed in those primeval times when there was an immense mass of vegetation on the face of the globe; that vegetation absorbed the heat. In these primeval forests it has been preserved, and in such fuel as coal it is restored. In being so restored or returned, that is given back to the earth which was absorbed perhaps before the creation of man. These buried forests are now aglow with light, and heat, and vigour—unmistakable types of resurrection from a grave. Let us turn to that received from the sun, and refer to the diagram of the spectrum which many of you saw last week, and consider how that diagram aids in illustrating the question of heat. On Monday last an endeavour was made to explain how it was related to the phenomena and energies of light, and incidentally to the phenomena and energies of chemical affinity. One portion is related to the energy of light, properly so-called; another portion is related to the energy of affinity, properly so-called; and in this portion, which is perfectly obscure, and which escaped notice until recent years,—in this which is invisible to the human eye, although it may be visible to the eyes of other animals, lies that which we call solar heat. You observe that to the spectators' left-hand of the portion marked with the usual prismatic colours there is a shade of red extended to a length equal at least to that marked with such decided colouring. It is not far from the truth to say that in this lies all the heat from which we obtain our stock of motion. It may be desirable to explain how we know that the heat lies there, and why the diagram is there drawn, and extending to such a distance from the visible portion of the spectrum, and that in such portion lies the greatest amount of heat. It is done in this way:—We take a little instrument called a line thermopile, composed of a number of strips of metal laid edge to edge, and soldered at the alternate ends. The two metals are usually antimony and bismuth. The pile is in the form of a straight line, because it is to be used for determining the heat at a particular portion or line across the spectrum.

Thermometers for heat purposes may be said to be useless, and, perhaps, before going further, it may be well to state why they are so. A thermometer is an instrument which, by the expansion of a fluid, as air, or a liquid, as alcohol, mercury, &c., or by any other means, tells us the difference in temperature between two bodies. If a thermometer be placed in water, it would tell us how much the temperature of the water is above the freezing-point, or how much below the boiling-point. But freezing- and boiling-points are neither of them standard points. There is heat far below the freezing-point, and there is heat still higher than the boiling-point; and indeed there is no approachable zero from which to commence the graduations of a thermometer. We want, too, another thing, not relative heat but absolute heat. Another means for obtaining records of heat is by the use of the thermopile and a galvanometer. This galvanometer is connected with the thermopile, and the speck upon the screen is that to which we have to look. If two short thin wires, one silver and the other copper, be taken, one wire attached to one end of that round the galvanometer, and the other to the other end, questions in relation to heat, and electrical phenomena in connection with it, may be made clear. If the free ends of the silver and copper wire be placed in contact and held between a finger and thumb, or placed near a lamp-flame, the speck immediately moves, and travels over a large space. No thermometer is so delicate or sensitive to heat as this combination of instruments. The heat which in a thermometer would be employed in expanding the liquid is in this case converted into an electrical current which affects the galvanometer. Heat in the one case is measured by the expansion of a liquid, in the other by being converted into electricity, and the electricity is measured, as explained in a previous lecture, by the galvanometer. The speck is now steady, but on

taking hold of the junction of the wires the speck moves in consequence of the simple touch of a finger. If the junction be once waved near the flame of a lamp, the speck moves directly—evidently there is a real and measurable energy in the heat which has passed. It should be remembered that this galvanometer requires quantity of electricity, and not what is called intensity. That notion, therefore, by being properly measured, enables us to get, inferentially, at the quantity of heat. The measurement of heat by differences of temperature is called "thermometry." The measuring of an absolute quantity of heat is called "calorimetry."

These metals thus indicating heat by the conversion of it into electricity are applied here in a line, and if this apparatus is placed in front of a real spectrum, of which that on the wall is a pictorial diagram, and moved gradually along by means of a fine-threaded screw, the line thermopile passes into successive portions of the spectrum, and according to the amount of heat in each portion, so the galvanometer deviates. If, therefore, the galvanometer at one portion is sent further aside than at another, we know it is owing to a larger quantity of heat being converted into electricity. Such an arrangement was carried out, and the largest amount of heat was found to be where that high mountain is marked on the drawing. This much must at present suffice for showing how to determine and measure the quantity of heat.

Now let the consideration be how this heat is converted into motion. Motion, we know, produces heat, but here the converse question is presented—heat producing motion. If we can show that heat produces motion, and if we know that motion produces heat, those two are mutually interchangeable. That no motion can take place without the development or absorption of heat may be made manifest by an experiment. Here is a thermopile, rather more delicate than the one hitherto used. Here is an air-pump, connected with which are two copper vessels separable by a tap. If, now, the air be exhausted from one of these vessels, the one nearest to the air-pump, it then becomes empty, and if the thermopile be caused to touch the other vessel, or to touch this one, which is empty, and the speck of the galvanometer is stationary; then, when the tap that separates the two is opened, air rushes from one into the other, and the galvanometer speck indicates a change in the heat relationships of the two vessels. These changing heat relationships result whenever action takes place. If a thermopile having a larger surface, intended for the purpose of investigating very delicate changes of temperature, be attached to a condenser which serves to increase the surface and so to magnify the result, it would be found that by merely touching one portion of the speck of the galvanometer moves. Now, if a fan be caused to act in front of and upon the thermopile, the impression would be that we should withdraw heat. The withdrawal of heat may be produced by the blast of air, but this air striking on the thermopile causes the spot of the galvanometer, to move in the direction indicating an increase of heat. The question is, whence comes that increase of heat? The answer is, that heat comes from my arm, and is produced by muscular energy being converted into mechanical power, which is then transformed to heat, which is changed into electricity. In this case the energy passes direct from my arm through the fan, and propels a current of air against the thermopile. If, however, the draught of air upon the thermopile, instead of being direct from my hand had been treated in this way,—if a close vessel had been taken, and by means of a condensing syringe, air had been forced into it, and allowed to remain for a few minutes, and then jetted against the thermopile in the same way as the air from the fan—we should find, after the first impact of air, that cold and not heat had been produced. Therefore the one blast blows hot, and the other blast blows cold. Thus, *Æsop's* fable of the man and the satyr appears to be realised. Much confusion has arisen from the use of the word cold, as though it was something distinct from heat.

"Cold" is only a condensation of the phrase "decrease of heat." Conflicting views would sometimes be harmonised were this word disused, and the word "heat" employed with a proper prefix.

There is a very good reason to be given for these results. The case of a blast producing decrease of heat may be illustrated thus:—In this iron bottle there is some condensed carbonic acid gas, which is under a pressure of about 700 lbs. on the square-inch. Now, it might be expected that as the blast from the fan produced heat, so the blast from this bottle of condensed gas would also. A jet of this condensed gas is now directed to the thermopile; the reflected light of the galvanometer by its motion indicates that the current has produced cold. It certainly appears remarkable that in the case of one blast heat is manifested, and in the other cold is produced. The explanation is this:—In neither case can the air be put into motion, except by the expenditure of heat. In the case of a fan the heat is at once expended in causing a blast of air, but in the other case the heat is expended in the previous act of condensation. When this condensing syringe has been used for two or three strokes, the cylinder of the syringe has become hot. The process of heat radiation is continuous. As soon as that bottle was filled, the heat accumulated in the work of condensation began to radiate. In other words, the muscular energy, which condensed the gas into the bottle, was dissipated in the form of heat. The contents of the bottle require an expenditure of that which may be represented by as much heat to get out of the bottle as they required to put them in; therefore this heat must be drawn from some source or other, and the first supplies are drawn from the contents of that which was in the bottle. The paradoxical and apparently contradictory phenomena are, however, reconcilable in a most instructive manner. In the case of the fan the blast carries the muscular energy converted into heat direct to the thermopile. In the case of the bottle this heat has been dissipated by radiation.

Let us now consider and describe how Mr. Joule obtained that which has become the basis of our calculations, and the arithmetical measurement of heat, namely, 772 foot-pounds as the mechanical equivalent of the amount of heat required to raise 1 lb. of water through 1° F., or 1390 foot-pounds for raising the same quantity of water through 1° C.

His experiments extended over about seven years, and the first apparatus used was the one shown in this diagram. There is a small vertical shaft capable of being rapidly turned by a handle: across or through the shaft is a short glass tube, in which were introduced a number of bars of wrought-iron. These were covered with oiled paper, so separating them electrically one from the other. The bundle was wrapped round with copper wire, and then inserted into the glass tube, which was closed at one end with a cork, and capable of being closed at the other. That glass tube was coated with tin-foil, so that in fact the tube was very like what is called a Leyden jar. It had an electrical coating inside and out, the only peculiarity being that a slit was cut along the coating on the outside of the vessel to prevent electrical induction. The tin-foil was then covered by strips of wood parallel to the tube, and bound all over with silk. The ends were corked, and also covered with oiled silk, so as to close it thoroughly. From the inside of the tube two wires passed down and dipped into two mercury cups, which were connected with a galvanometer, so that currents of electricity, if any were produced in the interior metal bars, would be manifested by the galvanometer. On each side of this short glass tube were fixed two arms of wrought-iron, bent in the form of a horse-shoe, and as nearly in contact with the ends of the glass as possible. This wrought-iron horse-shoe had a coil of copper wire round it, and by the usual means it could be converted into an electro-magnet. A certain weight of water was put into the short glass tube along with the bars, and having rotated the instrument for a quarter of an hour, the temperature of the water

when examined was found to be hotter than before. The galvanometer being observed it was known what electricity had passed, and this, combined with the change that had taken place in the temperature of the water after fifteen minutes rotation of the shaft, at the rate of six hundred rotations per minute, sufficed for determining the amount of electricity converted into heat. Thus, approximate data were obtained on which to found other experiments. Such experiments were made and re-made, they failed, and were again renewed; and to note how Mr. Joule overcame one difficulty after another, until he succeeded, furnishes a beautiful example of perseverance. Sometimes where he expected to find a substance had gained heat, he found, on the contrary, it had lost. Such anomalies, however, were afterwards completely accounted for.

Research in science claims the exercise of much ingenuity under unexpected and baffling conditions. The perplexity just described became an element in success. Mr. Joule availed himself of the process of "interpolation," and so adopted what proved of great assistance in future experiments. What has been described was the earlier of many processes. Next, he found it needful to measure the energy exerted upon the handles, because if in this vessel a quantity of heat had been generated which produced an observed increase of temperature in the water, it was desirable to know what was the value of the mechanical energy which had caused that heat to be so generated. If motion be given by the hand only, there is no means of measuring that value. The earlier object was to see if heat could be obtained; then the next object was to measure the heat obtained, and also to measure the mechanical energy by which it had been obtained. The apparatus now assumed this form. He gave up the electrical process, and began to take a vessel, similar to the one shown in this diagram, which had brass plates in it, and brass bars fixed to the inside of the vessel, and running across, so that paddles could rotate between the bars. The vessel was filled with water, and therefore, when the paddles rotated, the fixed bars stopped the whirl of the water, and heat was developed. The sea, as those who are accustomed to bathe know very well, is warmer on a windy day than on a calm day, simply because the motion of the water caused by the wind is converted into that motion of the molecules of the water which we call heat. So in the experiments with this apparatus, the motion of the water in the vessel is converted into the motion called heat. Of course all possible means were adopted to prevent heat passing by radiation from the exterior of the vessel. Hence the vessel was enclosed in another, and that again in another. The contrivances for ascertaining a measure of the mechanical effort made to keep the paddles rotating at a uniform rate were very simple.

The little vertical shaft on which the paddles were fixed was prolonged upwards, being divided across and re-connected in line by a piece of vulcanite, which, in common phraseology, would be called a non-conductor of heat. Wound round the upper part of this shaft were two cords, the ends of which passed over two pulleys on opposite sides. To these cords were fixed weights, by the descent of which motion could be given to the paddles. The cords were two in number, and on opposite sides, in order to obviate as far as possible the heating effect of rubbing friction on the shaft journals. With this apparatus, and others constructed upon similar principles, a series of experiments enabled him to arrive at certain definite conclusions.

In a research of this kind, made with apparatus constituted as new thoughts and new experiments suggested, it was not to be expected that the tabulated results should speak with one consenting voice. They did, however, seem to proclaim this—that the mechanical equivalent of heat competent to give an increase of temperature of 1° Fahrenheit to 1 lb. of water, was between 500 and 800 foot pounds. Detecting and

eliminating those elements which seemed to affect the accuracy of the result, he was enabled at last to come to this conclusion, that 772 lbs. was the exact number which was the mechanical measure, or, as it is commonly called, the mechanical equivalent of heat. That means this—he found how much a known quantity of water was raised in temperature by a recorded mechanical exertion, and he deduced the measure of that exertion needful to raise 1 lb. of water 1° on Fahrenheit's thermometer. Thus he found that that heat, applied to raise weights, would lift 772 lbs. through one foot; that is, if you had 772 lbs. weights here, and lifted them a foot high, it would be the same thing exactly as applying the same force to 1 lb. of water, and raising the temperature 1° Fahrenheit.

There is a table written out mathematically, by means of which the 772 lbs. are deduced. Mr. Joule having made these experiments, others followed, and we have a table showing the means used, air, friction, steam, Daniell's battery, electro-magnetism, &c.; also the names of the experimentalists, and the mechanical equivalent of heat, as determined by them. Although the results differ from Mr. Joule's 772 lbs., yet his figures are now generally adopted.

The title of this lecture includes the words measurement and utilisation. The utilisation of heat is so important a commercial as well as scientific question, that there are one or two matters bearing upon it which may be worth present attention and much future thought from all. That we do not obtain in a steam-engine more than a quarter of the heat we expend in the furnace is now generally recognised. There is a table here, based upon Mr. Joule's calculations, which gives the number of horse-power—a technical term, meaning 33,000 units of work, which could be obtained by utilising the heat required for passing nine pounds of ice through its physical and chemical changes. If we have 9 lbs. weight of ice, and attempt to melt and convert them into liquid, a certain amount of heat is absorbed or rendered "latent," as it is called. At any rate there is a quantity of heat that does not show itself upon the thermometer. Then, after it is converted to water, if we gradually raise the temperature to 212°, there is another large quantity of heat rendered "latent" in the conversion of this water into vapour, and if we then convert that vapour which comes from the water into its elemental gases, viz., oxygen and hydrogen, another large quantity of heat is absorbed or rendered "latent." Now take that process backwards; assume we can take this 9 lbs. of oxygen and hydrogen and re-convert them back again into ice, and that it was in our power to use the heat which had been given off, then we get the quantity shown in the table. If we burn a quantity of hydrogen in oxygen it is converted into water; if one part of hydrogen and eight parts of oxygen are combined by an electric spark or other means, and converted into water at 212°, a number of units of heat equal to 145½ horse-power are obtained. If, then we pass it still further into the form of water at 32° we should obtain 38 horse-power more; and if we then pass it from the form of water into the form of ice, we should obtain 30 horse-power. Therefore, if we obtain 9 lbs. of ice from its primeval elements, viz., 1 lb. of hydrogen and 8 lbs. of oxygen, we could utilise as a mechanical agent all the heat set free, then from the data given we see that there would be obtained 159½ horse-power of work. But we cannot obtain this. What becomes of the heat, where it goes, and why we cannot contrive to utilise it, are inquiries which yet perplex scientific students. Various surmises have been made, but none of them have been accepted, except as the vague guesses of an unsolved riddle, the best of which are taken, though there remains a lurking feeling that none of them are right.

There is another table bearing on this question, viz., the advantage of using steam at a higher pressure than what is called low-pressure steam. If we take water at 35°, that is just above the temperature of ice, and that

be warmed until it attains the temperature 213°, it would occupy a bulk 1666 times as large as it was in the form of water. There is a relation between the pressures and temperatures which must be maintained, in order to preserve the whole of the water in the form of steam. These relations are expressed in the first two columns in the following table. The third column expresses the resulting volume of steam. The fourth column is the product of the pressure and the volume, and, therefore, represents the mechanical value of our unit of water. How much and at what rate this value or power increases with an increase of heat, and a correspondent increase of pressure, may be known by considering the figures in this fourth column. These figures represent the advantage of using steam at high pressures, and, therefore, high temperatures:

STEAM FROM WATER.

Pressures.	Temperatures.	Volumes.	Pressure multiplied by volume.
lbs.	Deg. F.	1	
15	39		
15	213	1666	25,035
25	240	1042	26,050
35	260	765	26,775
45	275	608	27,360
55	288	506	27,830
65	299	434	28,210
75	308	381	28,575
85	317	340	28,900
95	325	307	29,165

The reason why we cannot work steam at some of these very high temperatures is this, that when we superheat it, we thereby prevent any of it being converted into vapour, and if it is not so converted into vapour we have no means of lubricating the faces of our slide valves, and the consequence is, the metals being heated, they soften, then scratch and tear each other's faces, and the engine is soon destroyed. As soon as we can get slide-valves made of some material which will bear this higher temperature without abrasion or scratching, then, probably, we shall be able to work superheated steam economically.

(To be continued.)

PROCEEDINGS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, December 18, 1873.

Dr. ODLING, F.R.S., President, in the Chair.

THE names of the visitors having been announced, and the minutes of the preceding meeting read and confirmed, Mr. Robert Williamson was formally admitted a Fellow of the Society.

The names read for the first time were those of Messrs. Howard Barrett, Thomas Pemberton Wiltshire, George Whewell, and John Young.

For the third time—Messrs. Edward H. Davies, Sydney Trivick, John Smyth, M.A., Edmund Richard Southby, Edward Daniel Stone, John Sutherland, Carl Schörlenner, F.R.S., and John Clement Souter, who were then balloted for and duly elected.

The PRESIDENT said the Fellows would doubtless remember a paper read before the Society, "On the Dioxides of Calcium and Strontium," by Sir J. Conroy; he had received a letter from Dr. E. Schöne, of Moscow, in which he pointed out that, as early as 1866, he had published a description of these compounds in the *Bulletin de la Société Impériale des Naturalistes de Moscou*, and which has also appeared in the *Ber. d. Deutsch. Chem. Ges.*, vi., 1172. Dr. Odling had also received another reclamation, from Mr. Horsley, with respect to Mr. Donkin's pro-

cess for determining the amount of nitrates in water, recently communicated to the Society, but he employs pyrogallic acid (CHEMICAL NEWS, vol. 28, p. 254) instead of phenol, and only as a qualitative test, not as a quantitative method.

The first paper, "On the Preparation of Standard Trial-Plates to be Used in Verifying the Composition of the Coinage," was read by the author, Mr. W. CHANDLER ROBERTS, Chemist to the Royal Mint. After sketching the history of the composition of the alloy employed for the English gold and silver coins, the author gave a table of the composition of the five gold and silver trial-plates since 1660, showing that they sometimes varied considerably from the standard of 916.66 for gold and 925.0 for silver. The alloy in the last gold trial-plate, that of 1829, consisted of equal parts of copper and silver, but since 1837 the coin itself has been alloyed with copper alone. The new trial-plate has been prepared by melting together pure gold and copper, the purity of which was guaranteed by its high electric conductivity; of course, repeated netlings were necessary before the proportions of the metals had been correctly adjusted. Assays of pieces taken from various parts of the plate showed that it was homogeneous. Much difficulty, however, was experienced in preparing the silver trial-plate, owing to the tendency which the alloy, when cast into bars, has to be richer in silver in the interior than on the exterior, as shown by the experiments of Levol. In order to overcome this, it was necessary to resort to an artifice—casting the metal in the form of a hollow cylinder, which was then cut open and rolled; this did not succeed, the upper and lower portions of the casting possessing different compositions. 1000 ozs. of standard silver were therefore cast into a plate 30 centims. long, 25 wide, and 5 thick, the surface to the depth of 4 m.m. being subsequently planed off. This was then rolled out, and portions of metal removed from all parts of the sheet for assay. By this means it was found that a comparatively small portion along one edge of the plate was homogeneous and to have the required composition; the rest of the sheet was removed, and this portion is reserved as the standard trial-plate. Owing to the impossibility of obtaining plates of alloys which shall be absolutely homogeneous, the author suggested to the Lords of the Treasury to supplement the standard plates by plates of perfectly pure gold and silver. The gold plate was precipitated from more than 100 gallons of solution of auric chloride by means of oxalic acid, and the silver plate was prepared by Stas's process of reducing an ammoniacal solution of argentic nitrate by ammoniacal cuprous sulphite. [The trial-plates were exhibited, as also a magnificent specimen of crystallised gold.]

The PRESIDENT having thanked the author for his communication, Mr. H. W. FIELD said his own observations quite agreed with those of Mr. Roberts. In 1852, under Sir John Herschel, the use of fine gold as a comparison for the standard was introduced; for this purpose pure gold was obtained, and from that time the coin had been made according to the standard of 916.66, and not according to the trial-plate of 1829, which was only 915.5. He had compared some of the earlier coins with the plates, and had found a great variation from the standard.

Mr. RIDSDALE said he had in his custody some of the earliest trial-plates, including that of 1447, in Edward IV.'s reign, of 99.48; on Oct. 16, 1660, this was changed for the new standard trial-plate of 916.66. He had not examined all the trial-plates.

Mr. H. J. CHANEY, of the Standards Department, said they were greatly indebted to Mr. Roberts for the care he had taken in preparing the new trial-plates, and desired to thank him on behalf of the Warden of the Standards.

Dr. BOYCOTT remarked that the gold alloyed with silver and copper was harder and wore much better than that alloyed with copper alone. He could confirm Mr. Roberts's remarks on the irregularity in composition of silver bars; in Mexican dollars, the bars for which were cast just the width of the coin, the centre of the coin varied considerably

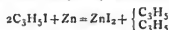
from the edges corresponding to the edge of the bar; in crown pieces, too, the centre usually contained more silver than the edges.

Mr. MAKINS was surprised to find that Mr. Roberts had such difficulty in obtaining silver bars of uniform composition. Levol's experiments were made on small quantities cast in iron moulds. The speaker had found that bars cast in very hot sand and slowly cooled were very uniform in composition throughout, and those cast in red-hot iron moulds were almost as good.

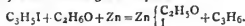
Mr. ROBERTS replied that he had tried casting at all temperatures; he had surrounded the moulds with ice, and he had used them red-hot, but he had not been so fortunate as Dr. Boycott, for he had never succeeded in obtaining homogeneous bars by this means.

Mr. CHANEY observed that the Warden of the Standards had been in communication with both Stas and Peligot on the subject, and they admitted that it was impossible to produce bars of these alloys which were perfectly homogeneous.

A communication, entitled "Researches on the Action of the Couple on Organic Bodies" (Part IV., "On Iodide of Allyl"), by J. H. GLADSTONE, Ph.D., F.R.S., and A. TRIBE, F.C.S., was read by the former. The action of the dry couple on allyl iodide at 100° gave rise to diallyl and a non-volatile resin, $n(C_3H_5)_2$, apparently isomeric with allylen; no gas was evolved, neither was any organic zinc compound produced, the principal reaction being—



The production of the polymeride of allylen the authors attribute to the zinc oxide unavoidably present in the couple. Unwilling to relinquish the hope of obtaining zinc allyl, they tried the action of the couple on the iodide in the presence of ether, but the result was substantially the same, no zinc allyl appearing to be produced. The action of the iodide on the couple moistened with water proceeds rapidly, giving rise to propylene, the reaction being $C_3H_5I + H_2O + Zn = ZnHO + C_3H_6$. The couple acts so violently on allyl iodide in presence of absolute alcohol that the experiment was modified by substituting for it granulated zinc, and even then the action becomes unmanageable unless the apparatus is kept cool. Alcohol of sp. gr. 0.805 acts more slowly, owing to the retarding influence of the water. The gas evolved is pure propylene, and the reaction thus affords an easy method for preparing that hydrocarbon; for this purpose, some granulated zinc and absolute alcohol are placed in a flask furnished with a delivery-tube and thistle-funnel, allyl iodide being gradually added as the gas is required—



Dr. ODLING, while thanking the authors for their interesting communication, enquired whether the action of the couple continued as long as any zinc remained.

Dr. GLADSTONE replied that it did, although the action became slower as the amount of zinc diminished.

Dr. WRIGHT said he felt some interest in the fact that the allylen was polymerised at the instant of its formation, and not given off as such; a similar reaction took place in the decomposition of sulphovinic acid, where polymerides of ethylen of high boiling-point were simultaneously produced. He might also mention that some time ago a process was patented for the preparation of aniline from nitro-benzol by means of a copper-iron couple prepared by treating the iron with a dilute solution of cupric sulphate.

Dr. R. SCHENCK read a paper "On Tetranickelous Phosphide." On pouring a solution of nickelous chloride into a boiling solution of potassic hydrate to which phosphorus has been added, a brown precipitate is immediately formed, which is soluble in dilute acids, but in a few minutes a black substance, insoluble in acids, begins to be formed; this, after purification, was analysed, and found to correspond pretty nearly with the formula for an oxyphosphide

of nickel, $\text{Ni}_4\text{P}_2\text{O}_4$. The experiment was accordingly modified by previously adding to the solution of nickelous chloride enough tartaric acid to prevent the precipitation of nickelous hydrate by the potash; the product, on analysis, was then found to have the composition Ni_4P_2 . When ignited in a current of hydrogen, the black compound changed its colour to dark grey, contracted in volume, and became much harder. The phosphide dissolves very slowly in dilute hydrochloric acid, readily in dilute nitric acid. In aqua regia it dissolves sometimes slowly sometimes quickly, as also in sulphuric acid. It is not magnetic.

The PRESIDENT thanked the author for his communication on this little-studied class of bodies. The tetranickelous diphosphide belonged to a class of compounds analogous to the sub-salts of copper in which the metal acted as a quasi-nonad; there was also a similar insoluble subphosphide of nickel.

Dr. WRIGHT remarked that the action of carbon monoxide on the oxides of iron, cobalt, and nickel, gave rise to suboxides of these metals, having the compositions Fe_2O , Ni_2O , Co_2O , in which the metals appeared univalent.

Dr. SCHENCK said the action of phosphoretted hydrogen on the metals, kept in solution by tartaric acid, produced phosphides much richer in phosphorus than those obtained from the hydrates, but he had not yet examined them.

A note, "On Ferrous Anhydrosulphate," was read by the author, Mr. T. BOLAS. On mixing a cold saturated solution of ferrous sulphate with nine times its volume of concentrated sulphuric acid, a white crystalline powder is deposited as the mixture cools, or immediately if the solution of iron is supersaturated. When microscopically examined, this powder is seen to consist of minute prismatic crystals, resembling Glauber's salt in form. Collected by means of a Bunsen's pump, and dried on a porous tile, they were found to have the composition of ferrous anhydrosulphate, FeSO_4 . Exposed to moist air, they absorbed water, and gave a salt of the composition $\text{FeSO}_4 \cdot 6\text{H}_2\text{O}$, but, when treated with water, they yielded crystals of ordinary green vitriol, $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$. The author is engaged in the examination of the precipitates produced by oil of vitriol in solutions of other metallic sulphates.

The PRESIDENT having thanked the author for his communication, Dr. C. R. A. WRIGHT read a paper "On the Hydrochloride of Narcein," in which the author said he could corroborate Petit's statement that, in order to obtain the normal hydrochloride of narcein, it was necessary to have a large excess of hydrochloric acid. With 8 or 10 equivs. of the latter, the salt was obtained, apparently having the composition $\text{C}_{23}\text{H}_{29}\text{NO}_9 \cdot \text{HCl} \cdot 2\text{H}_2\text{O}$. When this was dissolved in fifty times its weight of boiling water, fine filamentous crystals were formed at 35° , having the composition $6(\text{C}_{23}\text{H}_{29}\text{NO}_9) \cdot \text{HCl}$. On thoroughly washing these with cold water, they lost hydrochloric acid, leaving a body of Petit's formula, $10(\text{C}_{23}\text{H}_{29}\text{NO}_9) \cdot \text{HCl}$, but it is doubtful if this is a definite compound, as it still loses hydrochloric acid by repeated crystallisation. Owing to the obstinacy with which the hydrochloric acid adheres to narcein, it has not hitherto been practicable to obtain it absolutely free from chlorine. This, the author thought, might be due to the presence of a chlorine derivative of narcein analogous to chlorocodine, but no evidence of the existence of such a body could be obtained, the action of strong hydrochloric acid on narcein, giving rise to a hydrochloride of a base having the formula $\text{C}_{23}\text{H}_{27}\text{NO}_9 \cdot \text{HCl}$. The new base is amorphous, sparingly soluble in ether, and its salts yield a dark blue-purple colour with ferric chloride.

The PRESIDENT said they were much obliged to Dr. Wright for his paper on this portion of his researches on the opium bases.

The meeting finally adjourned until Thursday, Jan. 15, 1874, when the following papers will be read:—"On the Action of Trichloroacetyl Chloride on Amines (I., Action

on Aniline)," by Dr. Tommasi and Mr. R. Meldola. "Researches on the Action of the Copper-Zinc Couple on Organic Bodies (Part V., On Ethyl Bromide)," by Dr. J. H. Gladstone and Mr. A. Tribe.

NOTICES OF BOOKS.

Quantitative Chemical Analysis. By Dr. C. REMIGIUS FRESENIUS. Sixth Edition, Translated from the Fifth German Edition by A. VACHER. London: J. and A. Churchill.

THE chemical world at large has long ago come to a conclusion as to the merits of the original work of Fresenius, and we, at least, see no grounds for appealing from its verdict. In noticing the present edition, our business, therefore, is merely with the translator, and the manner in which he has fulfilled his duties. When speaking of the fifth English edition, we had occasion to express our disappointment at its wide departure from the original. We learn from Mr. Vacher's preface to the work now before us that Dr. Fresenius took a similar view. To abridge or condense a book of this kind is only possible by impairing its usefulness, and by omitting more or less those seemingly minute, but not the less necessary, precautions which the author's wide and prolonged experience had suggested. We are therefore unfeignedly glad to find the "Quantitative Chemical Analysis" once more appearing in an English dress unabridged, and with its known and approved peculiarities. We confidently expect for this edition a wide and rapid sale among students and chemists who have been unable to meet with a copy of the fourth edition, and who all will rejoice with us to find Fresenius "is himself again."

CORRESPONDENCE.

SEPARATION OF IRON AND ALUMINA.

To the Editor of the Chemical News.

SIR,—The separation of alumina from iron is occasionally a point of slight difficulty with those who are unable to procure pure alkalies; it may be of interest to some to be made aware that a boiling solution of barium hydrate answers the purpose perfectly well. The iron sesquioxide may be dissolved in sulphuric acid, reduced with zinc, and titrated by permanganate or bichromate, and, the barium having been extracted by similar means from the filtrate, the precipitated barium sulphate is to be separated by decantation and washing, when, in the liquid thence obtained, the aluminic hydrate is precipitated by ammonia with the usual precautions. The estimation of the iron, if performed volumetrically, is scarcely, if at all, interfered with by the presence of barium sulphate, so that it is scarcely worth while to separate the latter before titration. —I am, &c.,

F. MAXWELL LYTE.

Chemical Laboratory, 6 Cité de Retiro,
Rue de l'Anjou Saint-Honoré, Paris,
Dec. 17, 1873.

ANALYSIS OF CIGAR-ASH.

To the Editor of the Chemical News.

SIR,—I am obliged to Mr. Simmonds for calling attention to the error in the analysis of cigar-ash. I find that 5.764 per cent of sodium sulphate has been omitted, which will bring the result to 100.—I am, &c.,

A. PERCY SMITH.

Berford, Dec. 15, 1873.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE. All degrees of temperature are Centigrade, unless otherwise expressed.

Bulletin de la Société Chimique de Paris, tome xx., Nos. 8 and 9, November 5, 1873.

Detection of Blood Spots by means of Tungstate of Soda.—M. Sonnenschein.—Tungstate of soda, strongly acidulated with acetic or phosphoric acid, throws down albumenoid matters from very dilute solutions. These precipitates, insoluble in a large excess of water, dissolve in alkalies, especially if hot. If defibrinated blood is treated with this salt, a red-brown precipitate is formed, which becomes clotty on boiling. All the colouring matter is thrown down. To detect blood spots by this means on clothing, &c., the suspected portion is cut off, and, after having been treated with distilled water, the filtered solution is precipitated with the above reagent. The precipitate, washed and treated with ammonia, takes a reddish-green colouration. If phosphoric acid is present, it must be carefully washed away before treating the precipitate with ammonia.

Toxicological Detection of Phosphorus in Presence of Fatty Bodies.—Van Bastelaer.—The liquid is repeatedly shaken up with ether; the ethereal extract is evaporated, under protection from dust. At the end of the operation, a few drops of distilled water are added to hinder the action of the air upon the phosphorus. Under the water is deposited a liquid globule, composed of phosphorus and fat. This is placed in a small tube, and agitated with strong ammonia at 21°; the ammonia is removed by washing, first with very dilute sulphuric acid, and then with water. The phosphorus then remains, with all its physical and chemical properties.

Hepatic Ferment.—M. Wittich.—The author proves that the hepatic ferment exists in the cells of the liver, and is not derived from the blood traversing that viscous.

On Albumenoids.—M. Eichwald.—The author combats the theory of Schmidt on the coagulation of fibrin. He proves experimentally that coagulation may take place when the paraglobulin or plastic fibrin has been completely removed, and is even hastened by the action of carbonic acid. Fibrin is thrown down on neutralising the blood with carbonic acid. The albumenoids are composed of one and the same substance, modified by its combinations with colloidal and crystalloidal bodies.

Casein and Coagulation.—F. Soxhlet.—The author considers the alkaline aluminates, and casein as identical. He ascribes the coagulation of milk under the influence of pressure to the transformation of milk-sugar into lactic acid. This view is combated by M. Heintz in another paper on the same subject.

Application of the Waste from the Manufacture of Bone-Gas to the Preparation of Pure Sal-Ammoniac.—J. V. Divis.—The purification of the ammoniacal salts from the waste of bone-gas works and animal-charcoal works is rendered difficult by the presence of empyreumatic animal matters (Dippel's oil). The crude products have to be re-sublimed, which materially adds to the cost of production. The neutralisation of the condensations with hydrochloric acid occasions a nuisance on account of the presence of ammoniacal sulphide and cyanide. The author has found a method of purification which may be used even in sugar-works which prepare their own bone-black. According to the quality of the bones, from 8 to 10 per cent of ammoniacal water may be obtained, containing from 7 to 9 per cent. of actual ammonia. The yield of bone-oil is 1.7 to 2 per cent. The ammoniacal waters are collected in old petroleum casks, and after standing for two days the supernatant oil

is decanted off. The water is then gently heated, and exactly neutralised with hydrochloric acid, after having been mixed with a concentrated solution of chloride of calcium to decompose carbonate of ammonia, without which there would be liberation of gas. Carbonate of lime is deposited in abundance, and its precipitation clarifies the liquid. After some hours it is decanted, when the sediment forms a good manure. The chloride of calcium must not be in excess, but rather slightly deficient. The decanted solution is clear and yellowish. It is heated to boiling in a sheet-iron tank, which causes the rest of the impurities to separate out when they are skimmed off. The boiling liquid is then filtered over a mixture of wood charcoal, animal charcoal, and coke placed in a double-bottomed cask. Finally the clear liquid is evaporated in shallow pans, the vapours given off being forced through the ash-grates of the furnaces. The sal-ammoniac thus obtained contains 95.3 per cent of true chloride of ammonium, and 4.2 per cent of water.

Use of the Aluminate of Soda to Preserve the Back-Cloths used in Calico Printing.—M. Kiehmeyer.—This invention refers especially to printing aniline blacks. The author dresses these cloths with aluminate of soda thickened with starch. This salt, by its alkaline reaction, destroys the aniline black, so that the piece may be perfectly purified after having served as back-cloth, and may even be ultimately printed. The use of aluminate of soda presents another advantage; the aniline black is destroyed on the "wrong side" of the pieces that are being printed, and as the black does not penetrate through the cloth, its fibre is less injured.

Tartar Substitute in Grain Dyeing.—M. Malfait.—This project has been commented on in *Reimann's Färber Zeitung*, and a notice of it extracted from that journal.

Antimony Blue.—C. Kraus.—The author obtains this colour by the improved process of boiling tartar-emetic with yellow prussiate of potash, and adding hydrochloric acid. The same colour may be produced, though less easily, by boiling the prussiate with hydrochloric acid, without the antimony. The antimony does not enter into the composition of this colour, but merely facilitates its formation, and may be replaced by mercury. The blue colour is, of course, merely a modification of Prussian blue, and has no right to the name of "antimony blue."

New Aniline Colour (Cinnamon-Brown).—This colour yields, on wool, silk, and cotton, a fine brown, which may be varied at pleasure by the addition of blue, red, or yellow dye-waters. On silk and wool it is applied without mordant. It is dissolved in warm water, and filtered after cooling. For silk it is acidulated with tartaric acid. For wool, 1 kilo. of sulphate of soda, and 250 grammes of sulphuric acid are taken to 20 kilos. of wool. The dyeing is performed at a boiling heat. Cotton is previously mordanted with tannin. Cinnamon-brown is obtained by means of one of the products formed in the manufacture of magenta. It is an acid salt of crysololuidin, $C_{21}H_{21}N_3$, a base derived from toluidin by the elimination of hydrogen— $3C_7H_9N-3H_2=C_{21}H_{21}N_3$. The base is insoluble in water, and is separated from the solution of its salts by alkalies, in the form of a light yellow precipitate. Its neutral salts are sparingly soluble in boiling water, which splits them up into an insoluble basic salt and a soluble acid salt. The solution of the acid salts is of a yellowish-brown colour; the alcoholic solution of the free base is a pure yellow. This shade is obtained on dyeing in a bath of the acid salt mixed with an alkali.

Manufacture of White-Lead, and Accidental Products which may be Formed on the German Method.—C. von Weise.—The German process for white-lead making is a modification of the Dutch. Sheets of lead are exposed, in spacious and closed chambers, to the joint action of air, vapour of water, and acetic acid, and of carbonic acid. The product is greyer than that produced by the Dutch method, and covers as well. It

covers better than the white-lead of the Clichy process; it is denser, finer in grain, and never crystalline, and requires less oil for painting. The German process yields a product more constant than the Dutch, as it is easy to regulate the access of air, of carbonic acid, and of the acetic vapour. Nevertheless, the progress of the operation presents certain difficulties which require much experience, and products may be formed which affect the whiteness and the covering properties of the ceruse. The best ceruse has the composition $2\text{CO}_2 \cdot \text{PbO} + \text{PbO} \cdot \text{H}_2\text{O}$. There are good specimens containing rather less hydrate of lead, but if the proportion of the latter becomes too low, the product is hard and unfit for use. In general, a ceruse is better the more hydrate of lead it contains, within certain limits. The injurious influence of an excess of carbonic acid is due to the crystalline structure which the product assumes. A sample of crystalline ceruse has a composition very like that of the neutral carbonate. The residues, likewise very hard, obtained by sifting and levigating the crude product approximate also to this composition, and are useless as a colour. In fine, the qualities of white lead may be classed according to their composition:—

	PbO.	CO ₂ .	H ₂ O.
1. First quality	86.80	11.16	2.00
2. Second quality	86.24	11.68	1.81
3. Third quality	86.03	12.28	1.68
4. Residues, very bad	84.69	14.10	0.93
5. Abnormal product, useless..	83.47	16.15	0.25

The products too rich in carbonic acid are grey. Another cause affecting the whiteness of the product is the formation of anhydrous oxide of lead, which is red or yellow. A sample of this red product gave on analysis:—

Oxide of lead	93.70
Carbonic acid	5.31
Water	0.90

99.91

Or 32.22 per cent carbonate of lead, 12.05 of hydrate, and 55.64 of anhydrous oxide. This anhydrous oxide is produced when the supply of acetic acid and water in the chambers is deficient.

Utilisation of Residues of Manganese in the Glass Manufacture.—The solutions of manganese, resulting from the manufacture of chlorine, may advantageously replace peroxide of manganese in glass works. The acid liquid is poured into a large wooden vat, which it fills to the height of one-third, and ground carbonate of lime is added. When the effervescence is over, the rose-coloured solution is decanted, free from iron, which has been precipitated by the chalk. The solution is now placed in a second vat with slaked lime, so as to produce a thick mixture. This turns brown rapidly on the surface. It is dried, and calcined in contact with air, till the brown colour is completely developed. The residue is then ground, and washed with water to remove the chloride of calcium.

MISCELLANEOUS.

A Christmas Puzzle for Chemists.—Mention an inorganic compound having for its distinctive name a word of nine letters, five of which are the vowels a, e, i, o, u, disposed in their alphabetical order.

University of London.—The following are lists of the candidates who have passed the recent Examinations:—*M.Sc. Examination* (Pass List).—Rickman John Godlee, B.A. (Gold Medal), University College. *B.Sc. Examination* (Pass List).—First Division. T. Barlow, B.Sc., University College; H. Colgate, University College; R. C. Lucas, Guy's Hospital; C. A. Rayne, University College; E. M. Skerritt, B.A., University College. *Examinations for Honours*—(B.A. and B.Sc. conjointly). *Logic and Moral Philosophy*.—First Class. F. Gotch, B.A. (Scholarship), University College; B. J. Leverston,

B.A., University College. Second Class. H. S. P. G. Chuckerbutty, B.A., University College; R. Lovett, B.A., Cheshunt College, and J. C. Wotton, B.Sc., Royal School of Mines (equal); E. K. Hollings, B.A., private study, and L. M. Simmons, B.A., City of London School and private tuition (equal). Third Class. A. G. Savile, B.A., private study, and J. W. Thompson, B.A., University College (equal); W. A. Foxwell, B.A., Wesleyan College, Taunton, and H. Norburn, B.A., private study (equal). (B.Sc. only). *Chemistry*.—First Class. A. S. Napier, Owens College, and J. C. Wotton, Royal School of Mines (equal). Third Class. J. A. Hullard, University College, and L. Lyell, private study (equal). *Geology and Palaeontology*.—Second Class. H. S. Robertson, Old Trafford School and Owens; S. H. Vines, Christ's, Cambridge, and Guy's Hospital; L. Lyell, private study; A. W. Fuller, Owens and Emmanuel College, Cambridge. Third Class. W. B. Worthington, Owens College; A. S. Napier, Owens College. *Zoology*.—First Class. A. M. Marshall (Scholarship), St. John's College, Cambridge. Second Class. S. H. Vines, Christ's, Cambridge, and Guy's Hospital; L. Lyell, private study.

Fletcher's New Low-Temperature Burner and Foot-Blower.—We have previously had occasion to notice some of Mr. Fletcher's improved appliances for the production and application of heat from gas. The "new low-temperature burner" by the same inventor seems likely to be not less widely appreciated. It gives a range of temperature varying, at the will of the operator, from a mere current of warm air to bright redness, and so perfectly under control that it may be advantageously used for drying, for prolonged digestion and evaporation, and a variety of other operations. It is considered likely to supersede to a great extent hot-air baths, water-ovens, sand-, oil-, water-, steam-, and solution-baths—apparatus which are all, from well-known reasons, more or less objectionable. We learn, in proof of the regular and equable character of the heat, that a common glass bottle may be placed on the tripod above the wire gauze at the top of the apparatus, and heated to any temperature that may be desired without the risk of breakage. When very low temperatures are required, below, or not much exceeding, the boiling-point of water, the gas is lighted through the aperture in the side of the furnace, and burns below the wire gauze. If a red heat is wanted, the light is applied above the wire, where the gas burns with a clear blue flame. By means of a specially adapted "blast-tube," the temperature can be raised to a bright yellow heat, bordering upon full whiteness, being regulated by the respective quantities of air and gas supplied. The "foot-blower" is an improved bellows which may be used with any kind of table blowpipe or laboratory blast-furnace; it appears convenient for working, well arranged, and not likely to get out of order.

NOTES AND QUERIES.

Petroleum.—A cellar has had petroleum stored in it. Is there any effectual method of getting rid of the smell? If you can help me to a solution of this difficulty you will oblige.—FRANK P. FERRIS.

Discharge for Chlorine.—Can any of your numerous readers inform me which is the least expensive discharge for chlorine from textile fabrics without affecting the colour?—A CONSTANT READER.

Sulphide of Sodium in Black-Ash.—(Reply to "A Subscriber.")—200 grs. in fine powder, 4 litre H₂O; temp., 44° C. Allow to stand for, say, two hours, with frequent stirring; filter, 250 c.c. (= 200 grs. dry black-ash) for sulphides, decant into basin, add standard solution (PbO₂) till all the sulphides are precipitated; nitrate of lead paper as test.—W. SIMMONDS.

Fuller's Earth and Resin Oil.—Crude resin oil being generally turbid, Fuller's earth, as well as other varieties of clay, is sometimes used as a clarifier. The powdered clay is mixed with the oil, stirred, and, when it has subsided to the bottom of the tank, the oil is filtered and comes out quite clear. But this is not literally refined oil. Crude resin oil contains a certain proportion of undecomposed resin, pyroxylic acid, and liquid hydrocarbons of widely different boiling-points, also solid homologues of naphthalin. To refine this crude oil it is necessary to re-distil it with slaked lime, and separate the successive products of the distillation. Having had considerable practical experience in the matter, I could give A. K. C. any further information he might require.—F. C.

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